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MCAS EL TORO
SSIC # 5090.3

MARINE CORPS AIR STATION EL TORO
EL TORO, CALIFORNIA
INSTALLATION RESTORATION PROGRAM
PHASE I REMEDIAL INVESTIGATION
DRAFT TECHNICAL MEMORANDUM
7 May 1993

VOLUME II

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Appendix A

NATURE AND EXTENT OF CONTAMINATION: OU-1 (SITE 18)
REGIONAL GROUNDWATER CONTAMINATION

A1: Groundwater
A2: Surface Water, Sediments and Angle Borings
A3: Background Soils

Appendix A
ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
AWQC	ambient air quality criteria
BCF	bioconcentration factor
Beylik	Beylik Drilling, Inc.
C	Centigrade
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CRDL	Contract Required Detection Limit
CWA	Clean Water Act
EC	electrical conductance
Eh	oxidation-reduction potential
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
FID	flame ionization detector
FS	Feasibility Study
FSP	Field Sampling Plan
GAC	granular activated carbon
gpm	gallons per minute
GPM	gallons per minute
H	Henry's Law constant
hp	horsepower
HPLC	High Performance Liquid Chromatography
ID	identification
Jacobs	Jacobs Engineering Group Inc.
kg	kilogram
K_{oc}	organic carbon adsorption coefficient
L	liter
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MCLG	MCL goal
mg	milligram
mm	millimeter
MP	multiple-port
MS	matrix spike
MSD	matrix spike duplicate
NPAQS	National Primary and Secondary Ambient Air Quality Standards
NPL	National Priorities List
O.D.	outside diameter
OCWD	Orange County Water District
OU	Operable Unit
OVA	organic vapor analyzer
PCBs	polychlorinated biphenyls
PCE	perchloroethylene (tetrachloroethylene)
PID	photoionization detector

POC	purgeable organic carbons?
POTW	publicly owned treatment works
POX	purgeable organic halogens
PPE	personal protective equipment
PPM	parts per million
PPMV	parts per million (volume)
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROICC	Resident Officer in Charge of Construction
RWQCB	(California) Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SMCL	secondary maximum contaminant level
SP	spontaneous potential
Station	MCAS El Toro
SVOCs	semi-volatile organic compounds
TAL	Target Analyte List
TCE	trichloroethylene
TCL	Target Compound List
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TFH	total fuel hydrocarbons
TM	Technical Memorandum
TOC	total organic carbons
TOX	total organic halogens
TRPH	total recoverable petroleum hydrocarbons
TSCA	Toxic Substance Control Act
TSP	trisodium phosphate
VOA	volatile organic analyzer
VOC	volatile organic compound
WDA	Waste Disposal Area
Westbay	Westbay Instruments, Ltd.
WSA	Waste Staging Area
μg	microgram

Appendix A
NATURE AND EXTENT OF CONTAMINATION: OU-1 (Site 18) - REGIONAL GROUNDWATER

Operable Unit 1 (OU-1) consists of groundwater on- and off-Station that is contaminated with constituents that may have migrated from other sites at MCAS El Toro. During the Phase I Remedial Investigation (RI), samples of surface water runoff, sediments, and soils beneath the washes upstream and downstream of the Station boundaries were collected in addition to groundwater data. The samples from the washes were designated as Site 18 samples because they evaluated pathways for contaminants to migrate to groundwater. Background samples, off-Station surface soil samples, and samples of potable water used for drilling were designated as Site 00 samples.

Appendix A1 discusses the results of Site 18 monitoring well samples and other groundwater sampling, where applicable. Appendix A2 discusses the Site 18 surface water, sediment, and angle boring investigation. Potable water is discussed in this appendix when water for drilling appears to influence the results of groundwater sampling. Appendix A3 describes background soil sampling and analytical results.

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Appendix A1

Nature and Extent of Contamination: OU-1 (Site 18) Groundwater

Appendix A1
NATURE AND EXTENT OF CONTAMINATION: OU-1 (Site 18) - REGIONAL GROUNDWATER CONTAMINATION (GROUNDWATER)

This discussion of OU-1 is supplemented by the figures and tables listed below. The figures begin on page A1-3, and the tables are grouped at the end of this appendix.

The following plates are in other sections of this technical memorandum:

Plates J-1 and J-2:	Still-type diagrams
Plate 1-1:	Map of all regional monitoring and production wells
Plate 2-1:	Aerial photograph base map showing all on-Station monitoring wells

Station Identification (ID) numbers have been used during the Phase I RI to designate groundwater monitoring wells. The Station ID Number (for example, 18 BGMW03E) consists of the site number (00 through 22) followed by two sets of two-letter designations and the well number. Wells in a cluster also have a final letter following the well number that indicates the depth interval.

The first two-letter group designates the function or location of the well:

BG = Background
DB = Deep Boring
DG = Downgradient
UG = Upgradient

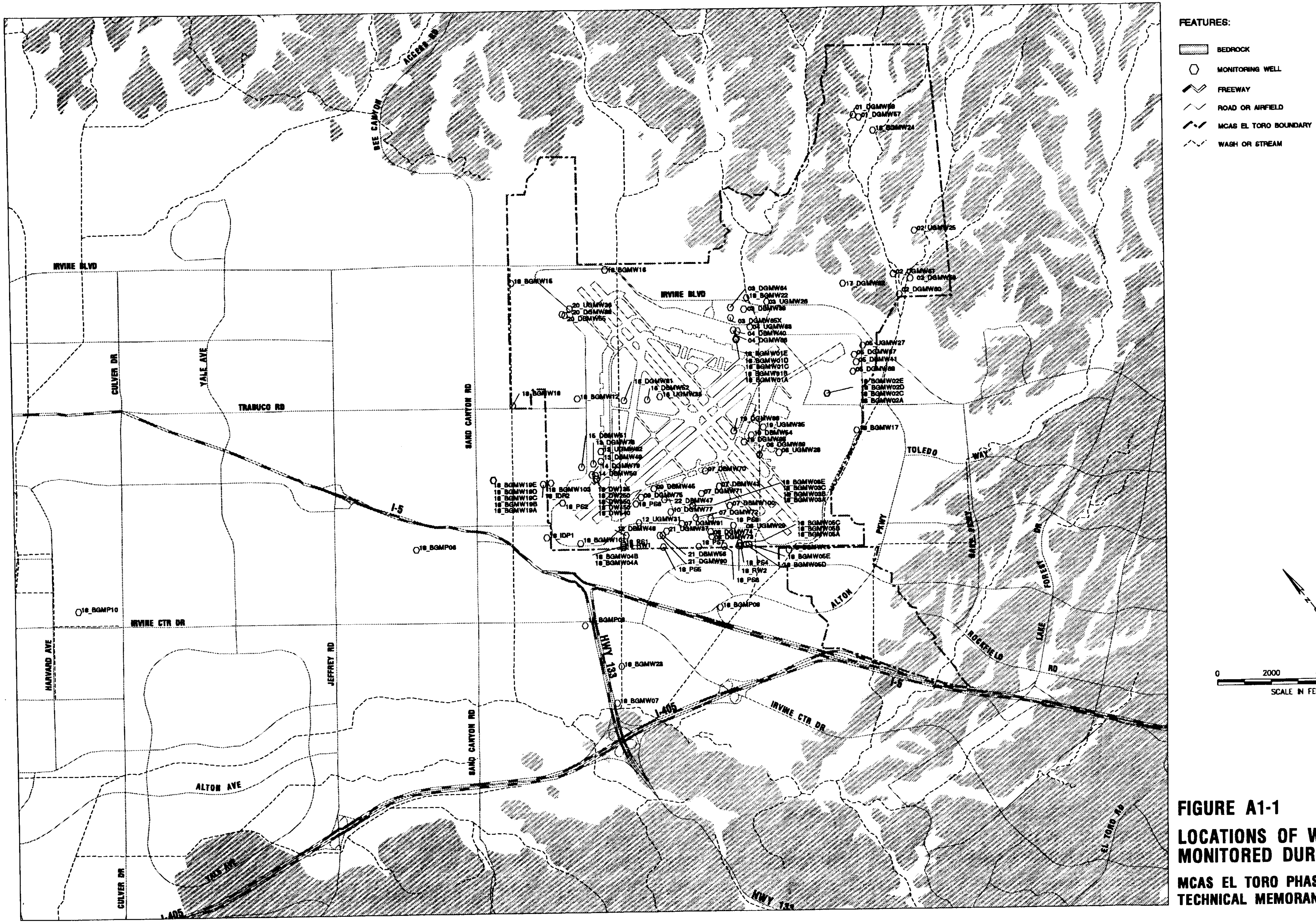
The second two letters indicate the type of well construction:

MP = Westbay well with multiple ports.
MW = Single-screen monitoring well

The Station ID number provides the unique number assigned to the well. The final letter (A through E) indicates that the well is one of a cluster of wells; the letters indicate successively shallower screens. Examples of the identification system are:

18 BGMW19E:	The shallow-most monitoring well in a Site 18 background well cluster
04 DBMW40:	The deep boring completed as a monitoring well at Site 4
07 DGMW75:	Downgradient monitoring well at Site 7

Off-station groundwater data collected during the latter half of 1992 through January 1993 was obtained from the Orange County Water District (OCWD) to supplement field


FEATURES:
BEDROCK
MONITORING WELL
FREEWAY
ROAD OR AIRFIELD
MCAS EL TORO BOUNDARY
WASH OR STREAM
0
2000
4000
6000
SCALE IN FEET
N
IRVINE BLVD
TRABUCO RD
CULVER DR
YALE AVE
SAND CANYON RD
JEFFREY RD
HARVARD AVE
IRVINE CTR DR
ALTON AVE
BEE CANYON
ACCESS RD
I-5
I-405
HWY 133
ALTON
PKWY
TOLEDO
WAY
RD
LAKE
FOREST
DR
ROCKFIELD
EL TORO RD
16_BGMW16
18_BGMW15
18_BGMW18
16_BGMP06
16_BGMP10
16_BGMP08
16_BGMW23
16_BGMW07
16_BGMW17
02_UGMW25
12_DGMW
05_UGMW27
01_DGMW57
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18_PS2

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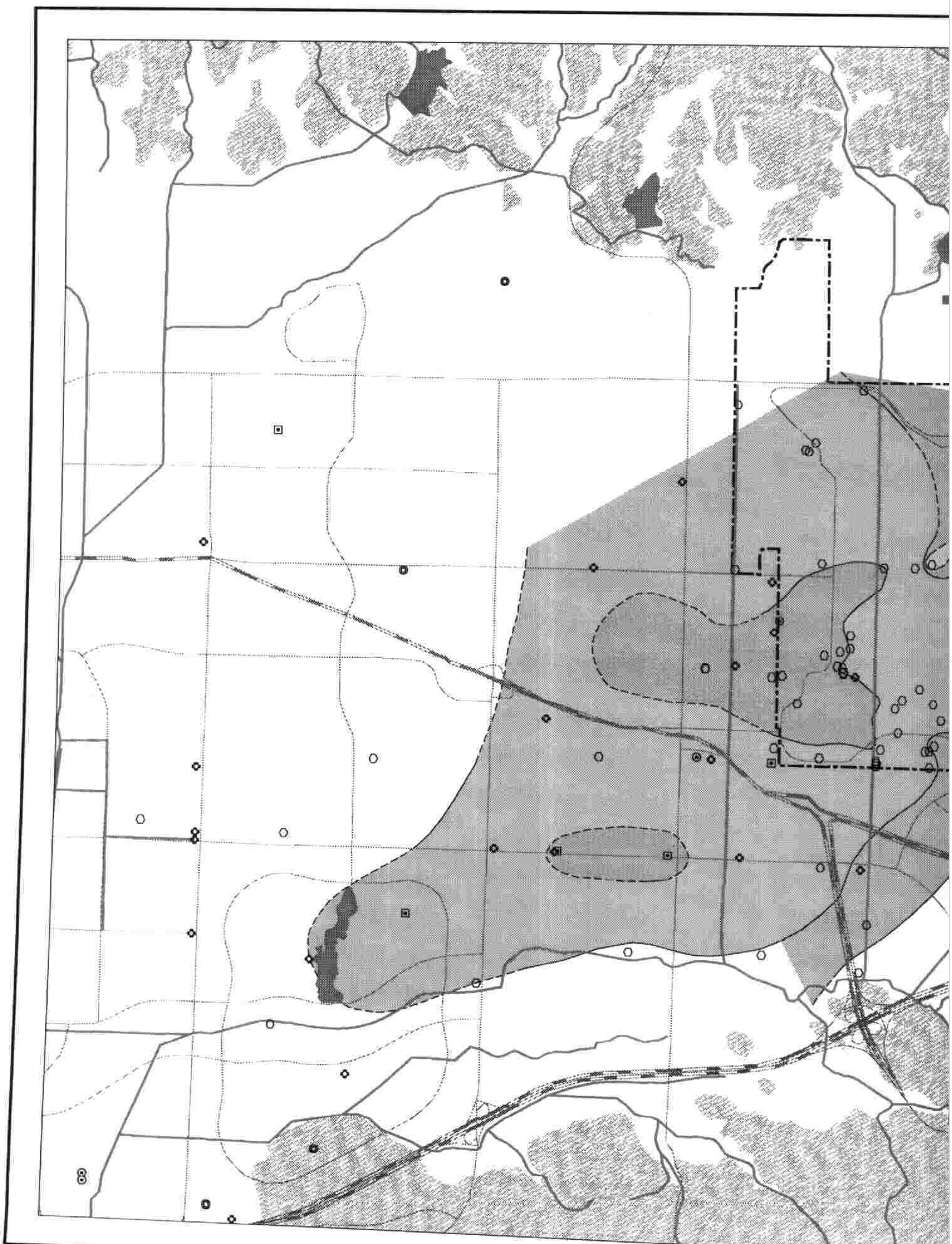

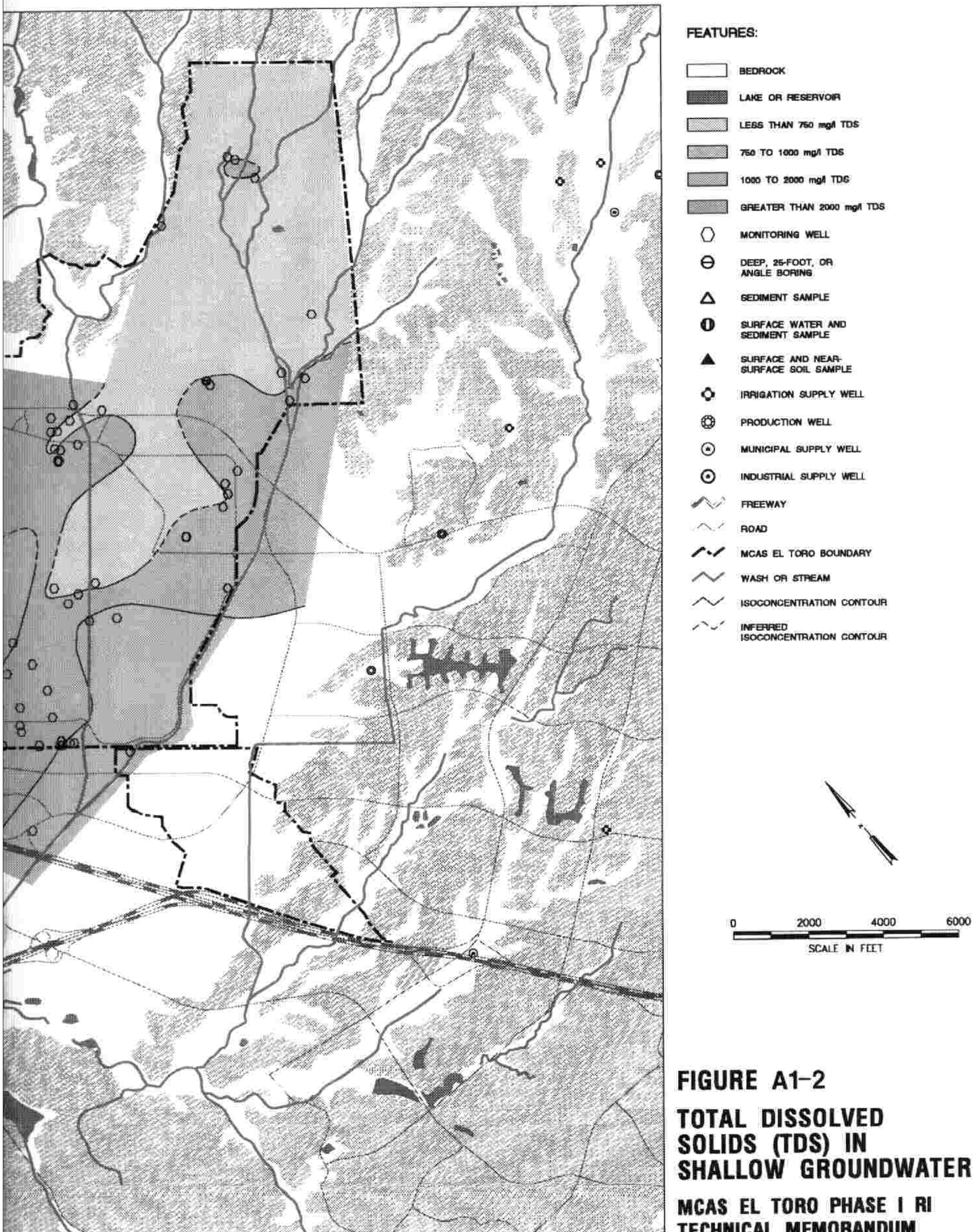

FIGURE A1-2

TOTAL DISSOLVED SOLIDS (TDS) IN SHALLOW GROUNDWATER

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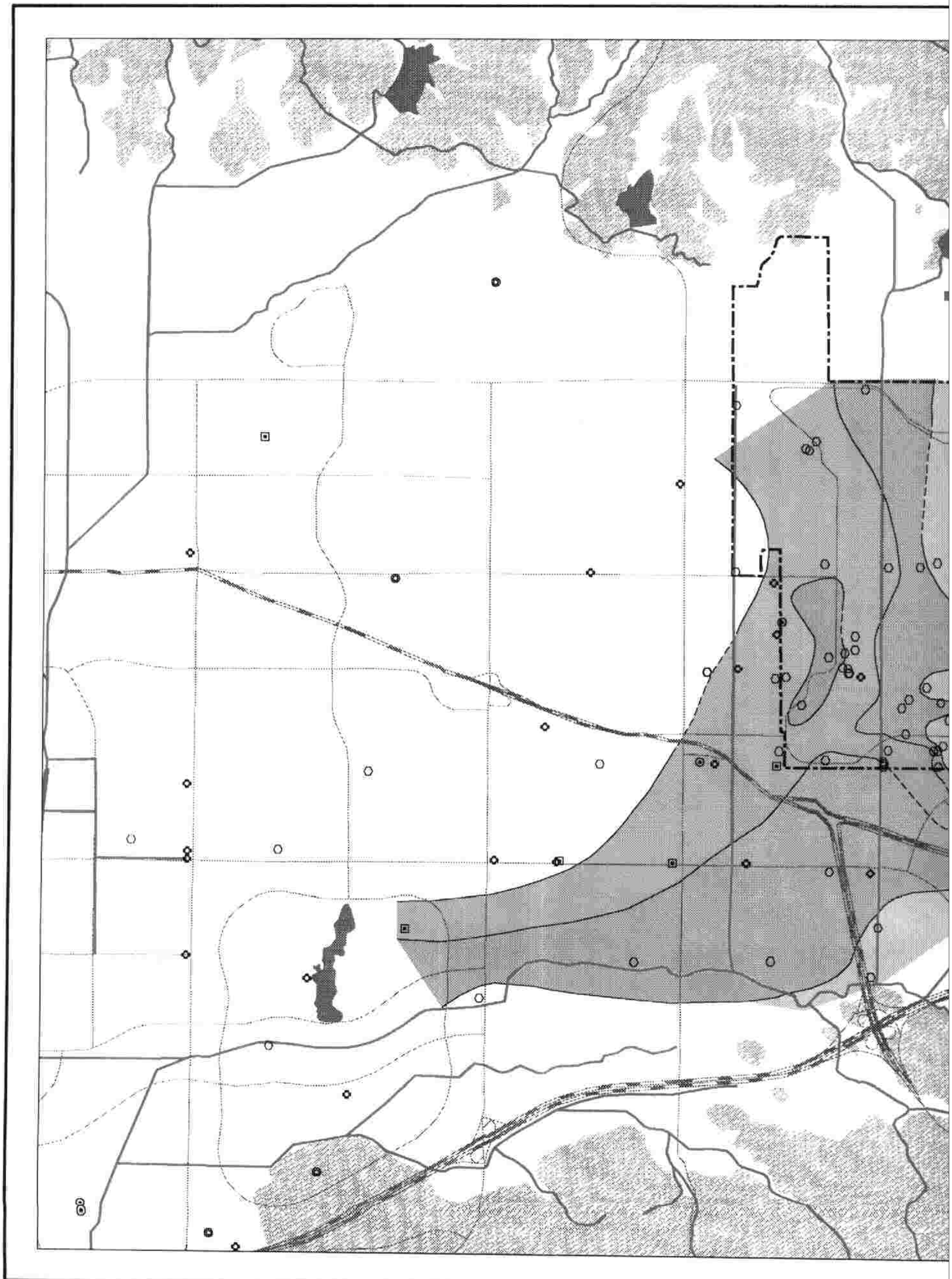

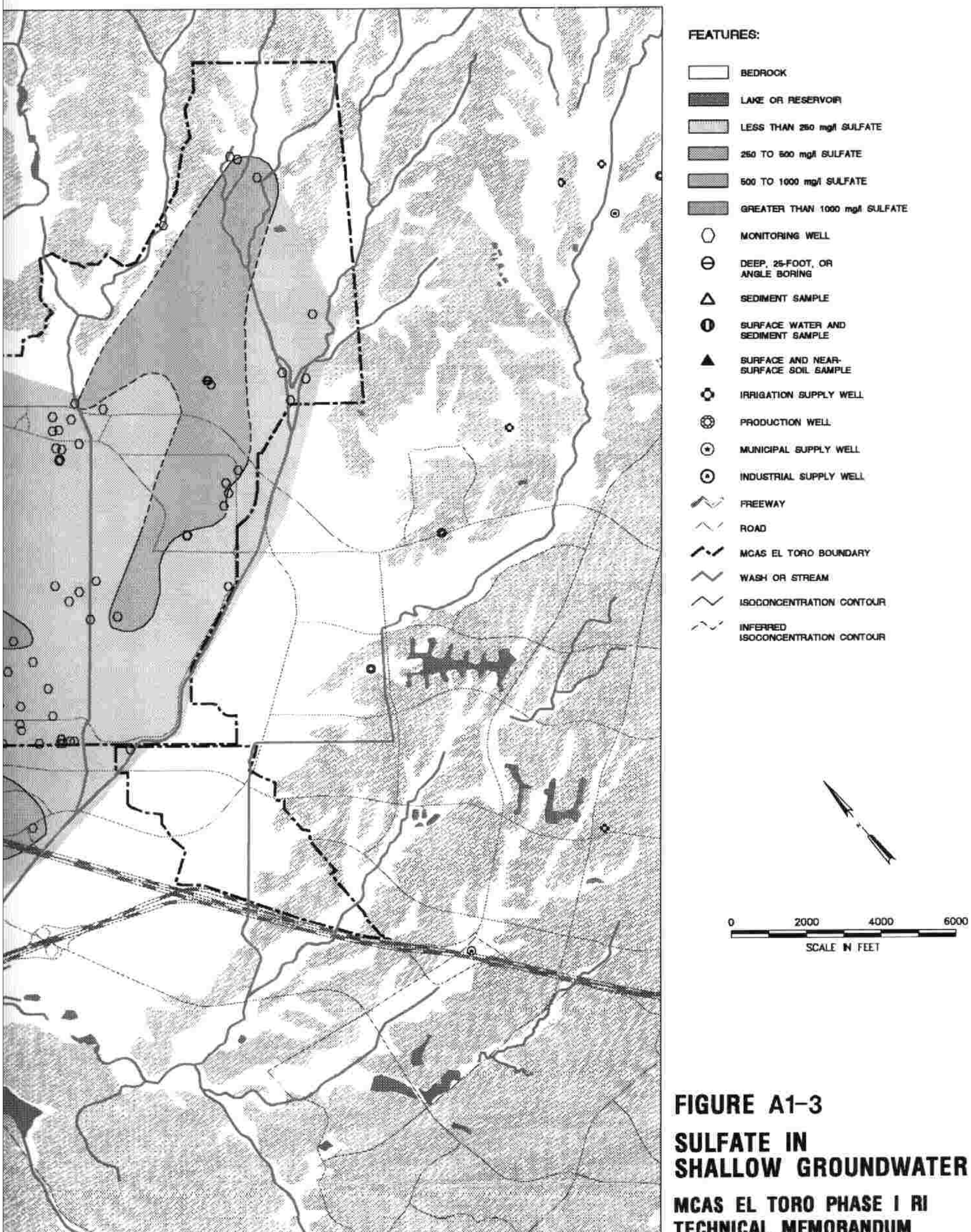

FIGURE A1-3

SULFATE IN SHALLOW GROUNDWATER

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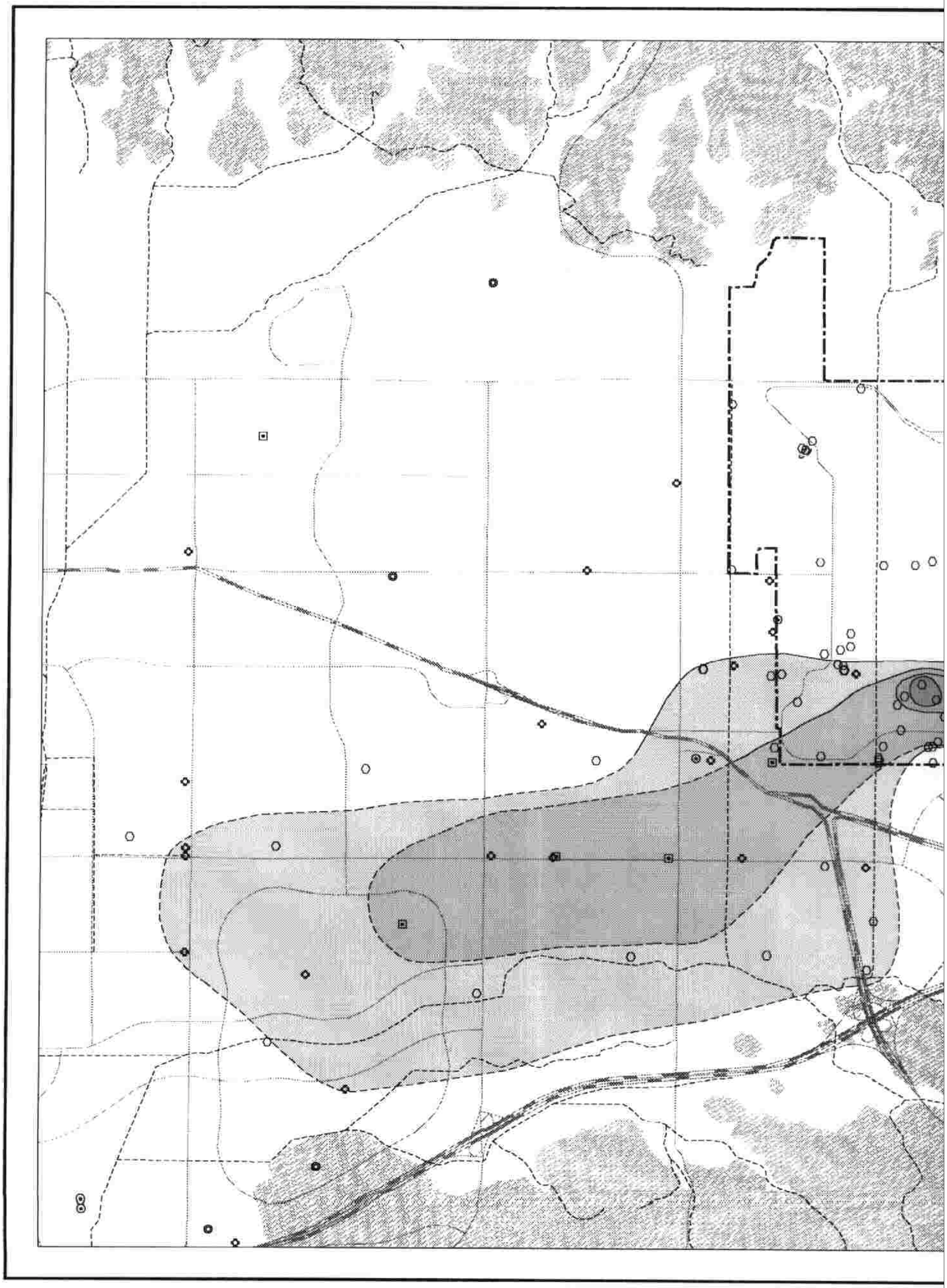

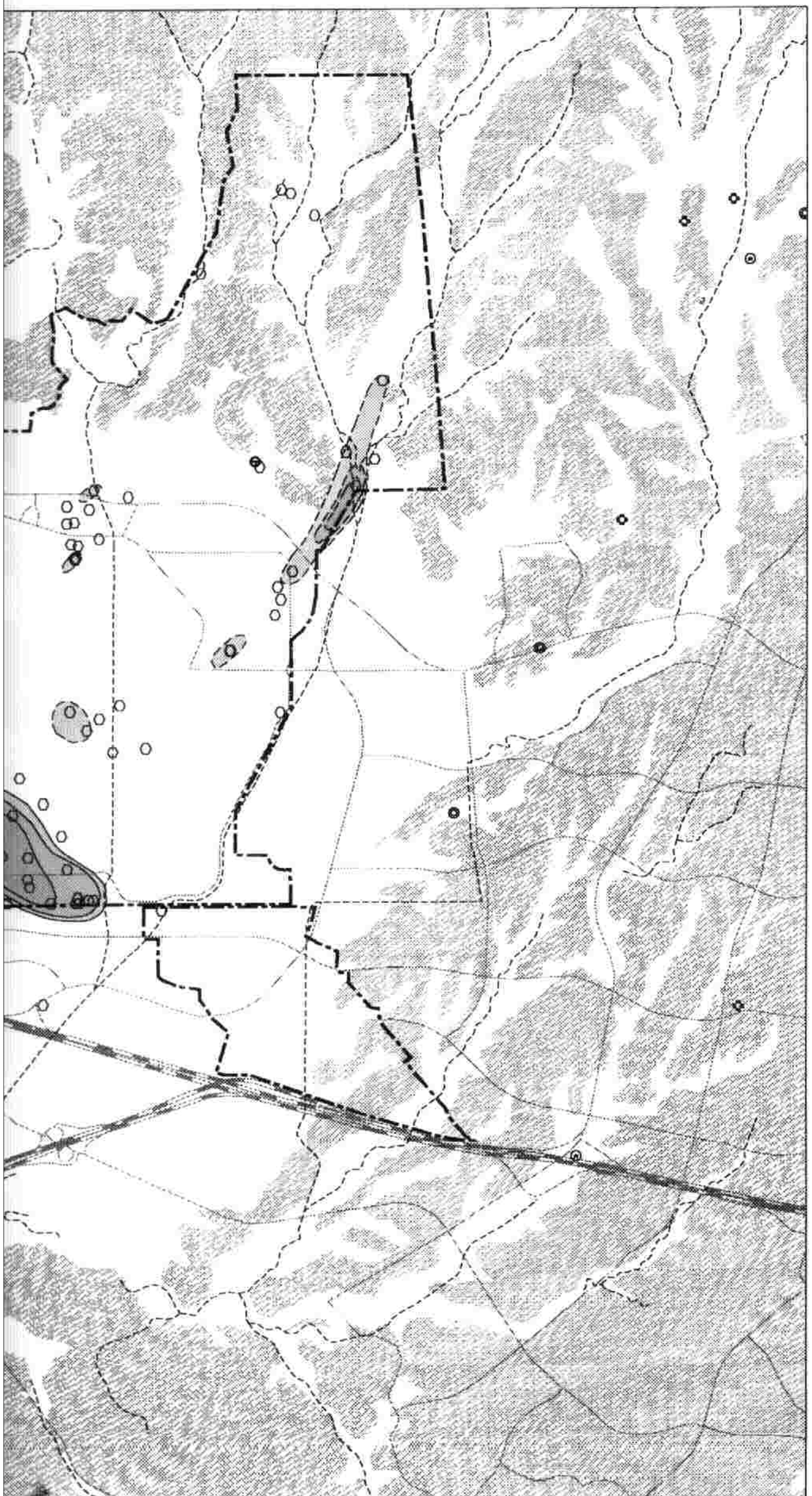

FEATURES:

- BEDROCK
- 0.5 TO 5.0 ug/l TCE
- 5.0 TO 50.0 ug/l TCE
- 50.0 TO 500.0 ug/l TCE
- GREATER THAN 500.0 ug/l TCE
- MONITORING WELL
- DEEP, 25-FOOT, OR ANGLE BORING
- SEDIMENT SAMPLE
- SURFACE WATER AND SEDIMENT SAMPLE
- SURFACE AND NEAR-SURFACE SOIL SAMPLE
- IRRIGATION SUPPLY WELL
- PRODUCTION WELL
- MUNICIPAL SUPPLY WELL
- INDUSTRIAL SUPPLY WELL
- FREEWAY
- ROAD
- MCAS EL TORO BOUNDARY
- WASH OR STREAM
- ISOCONCENTRATION CONTOUR
- INFERRED ISOCONCENTRATION CONTOUR

0 2000 4000 6000
SCALE IN FEET

FIGURE A1-4a
SITE 18 (OU-1): TRICHLOROETHYLENE (TCE) CONCENTRATION IN REGIONAL GROUNDWATER

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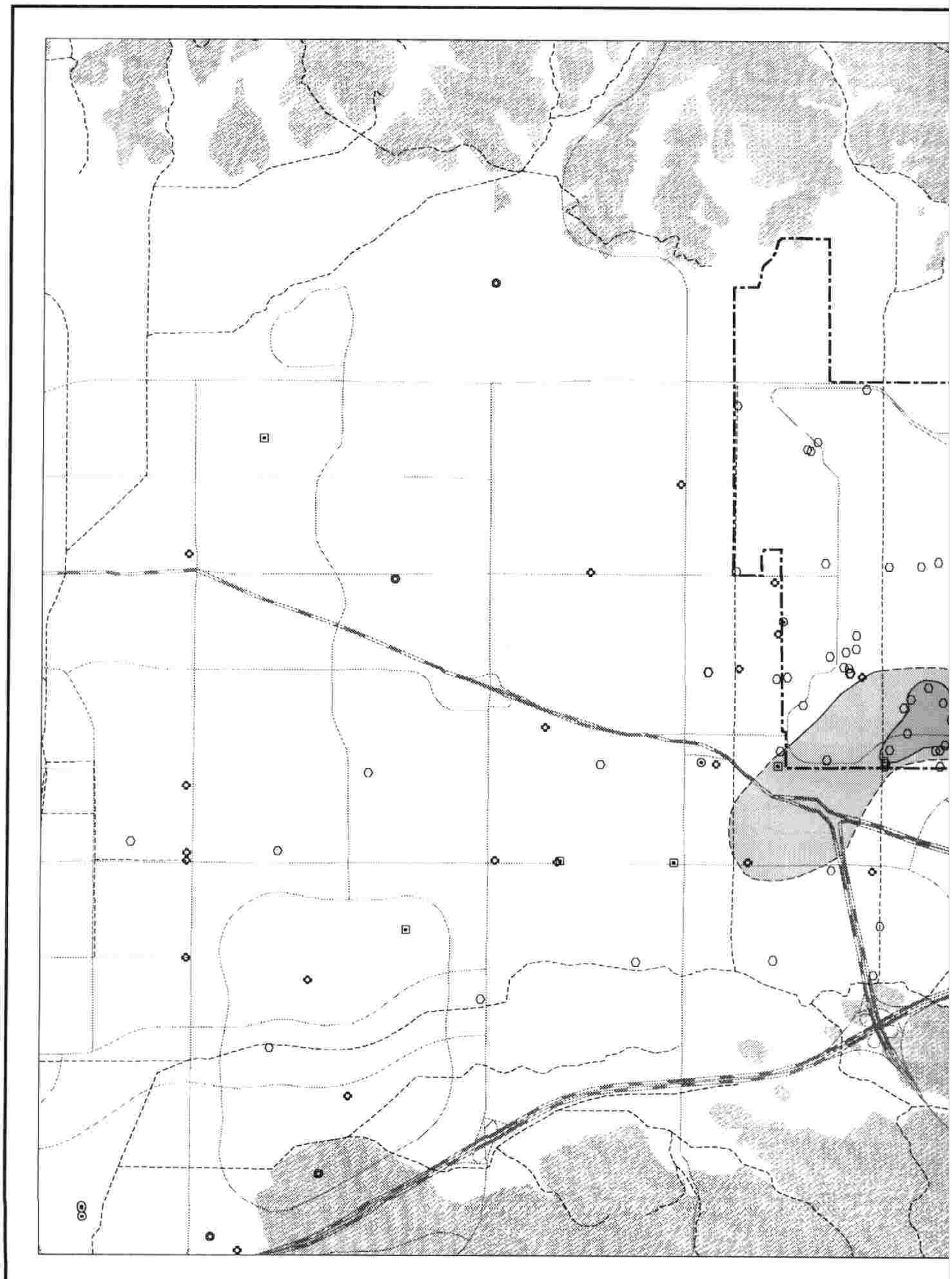

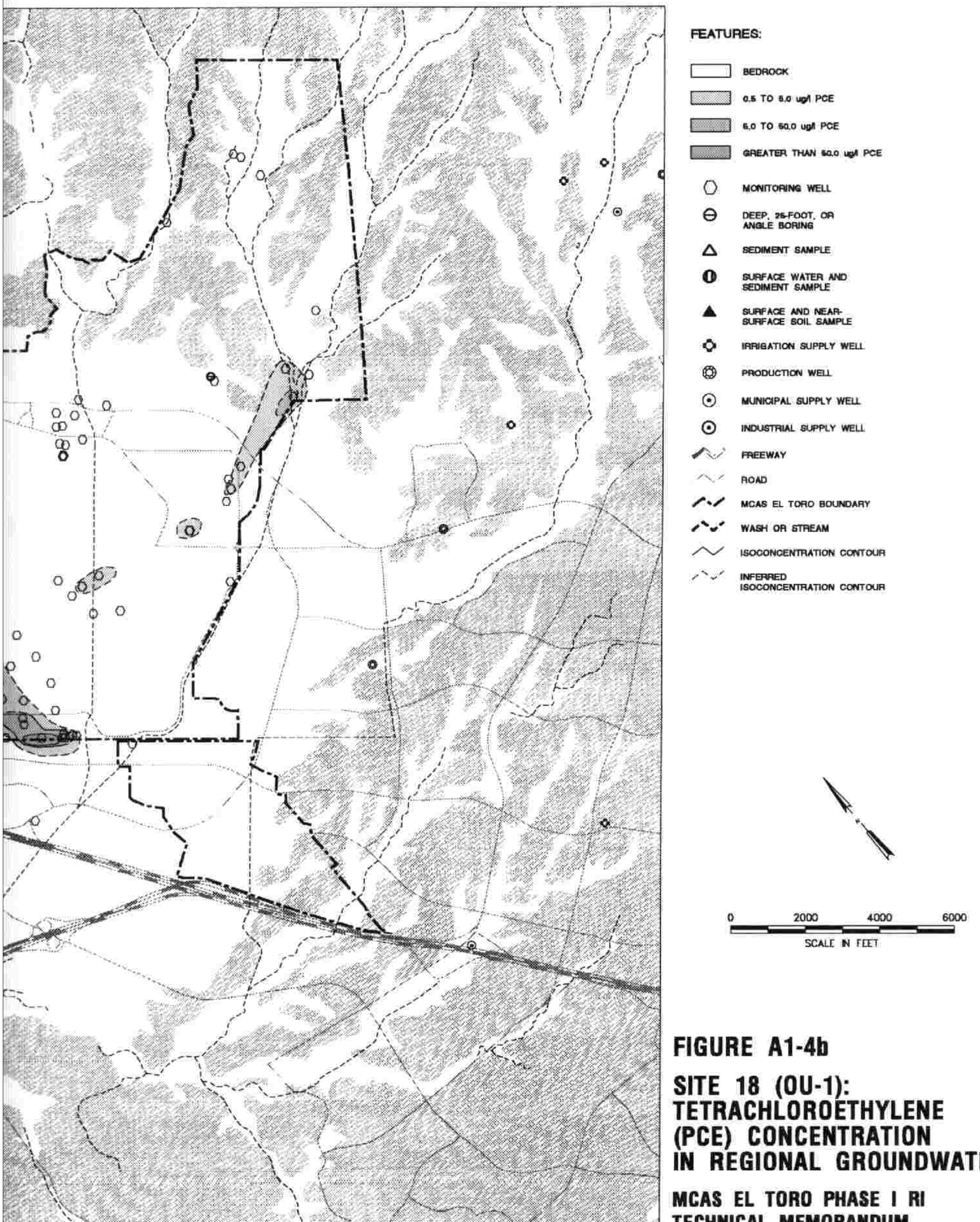

FIGURE A1-4b

SITE 18 (OU-1): TETRACHLOROETHYLENE (PCE) CONCENTRATION IN REGIONAL GROUNDWATER

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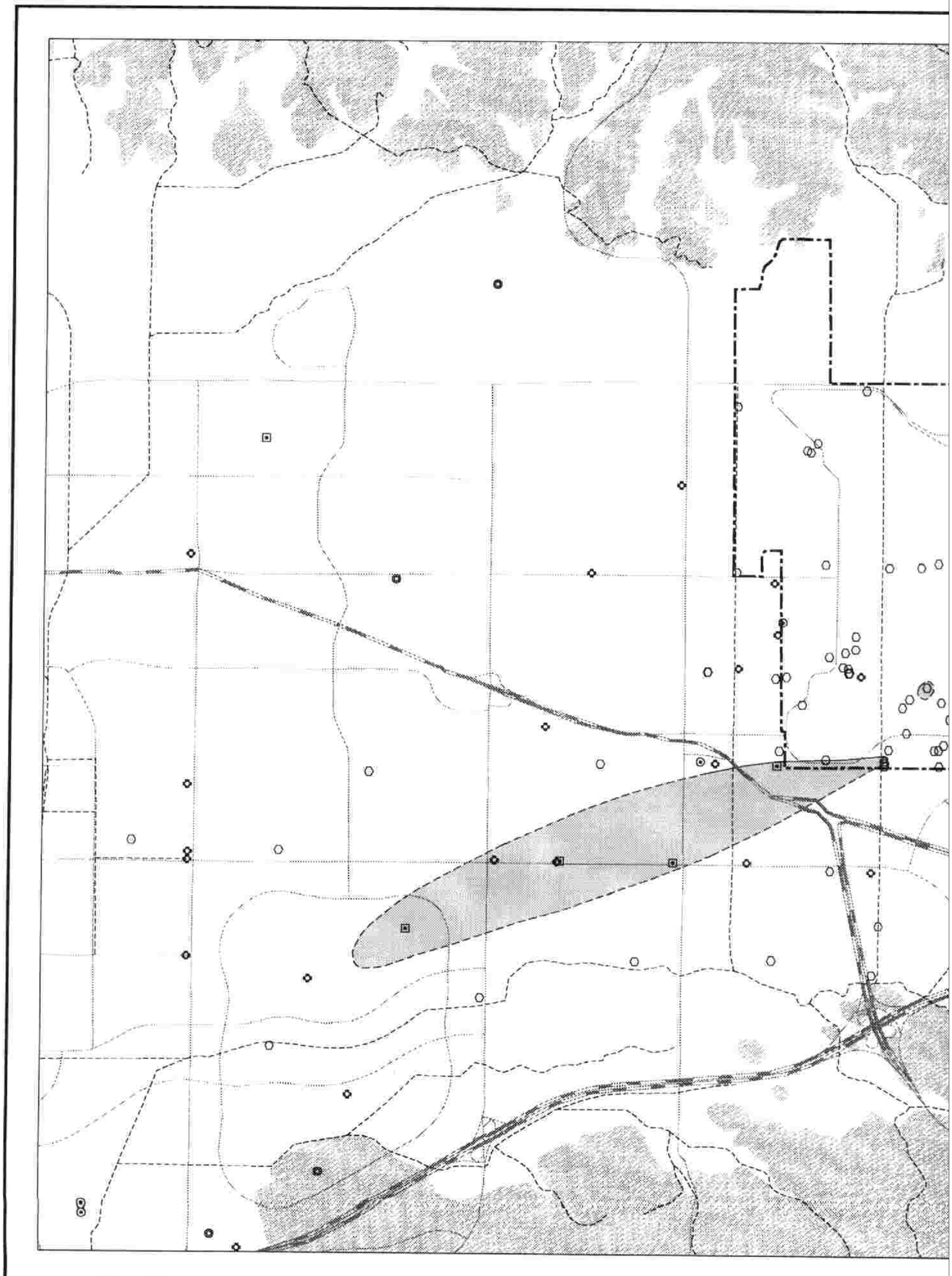

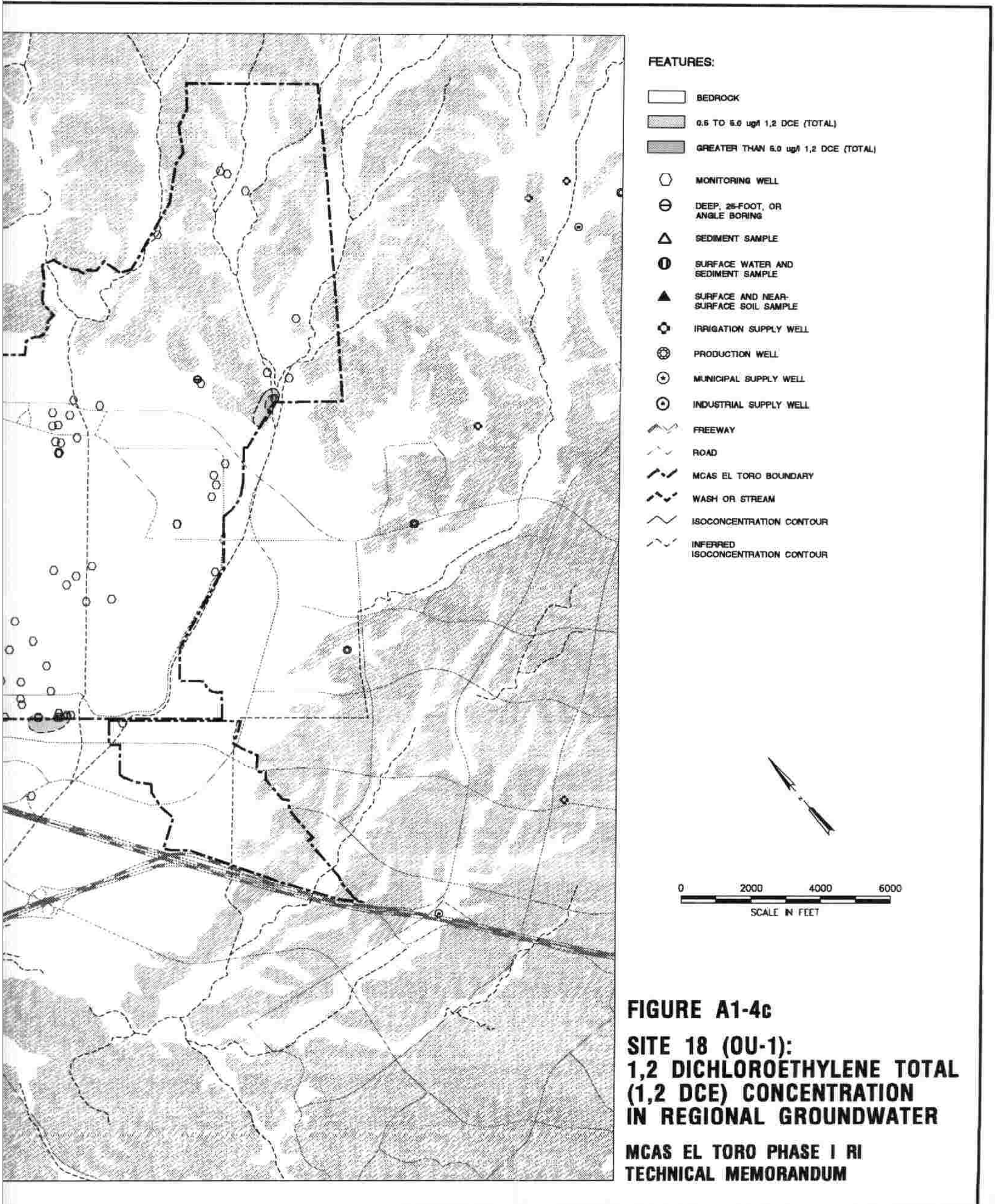

FIGURE A1-4c

SITE 18 (OU-1): 1,2 DICHLOROETHYLENE TOTAL (1,2 DCE) CONCENTRATION IN REGIONAL GROUNDWATER

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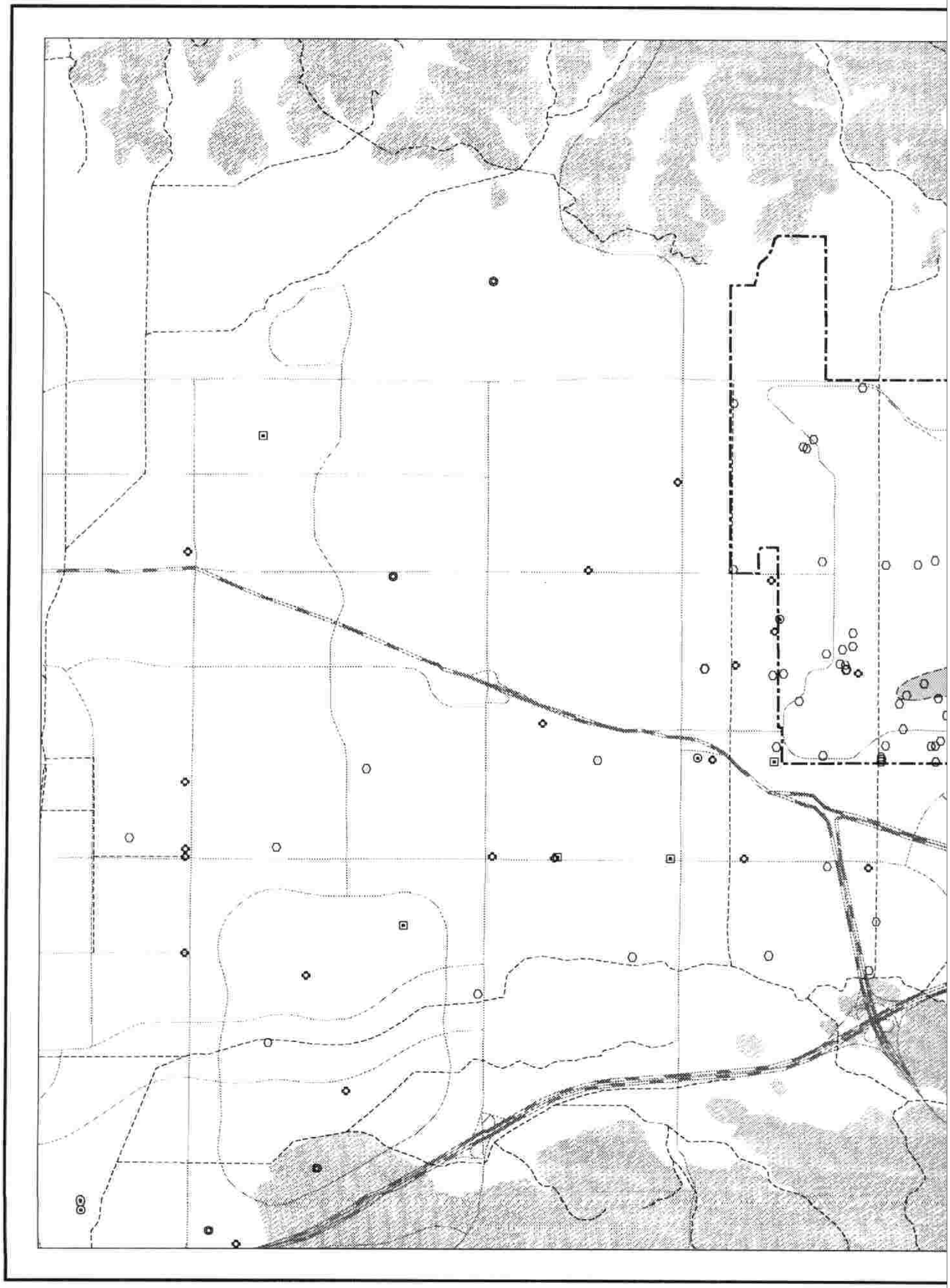

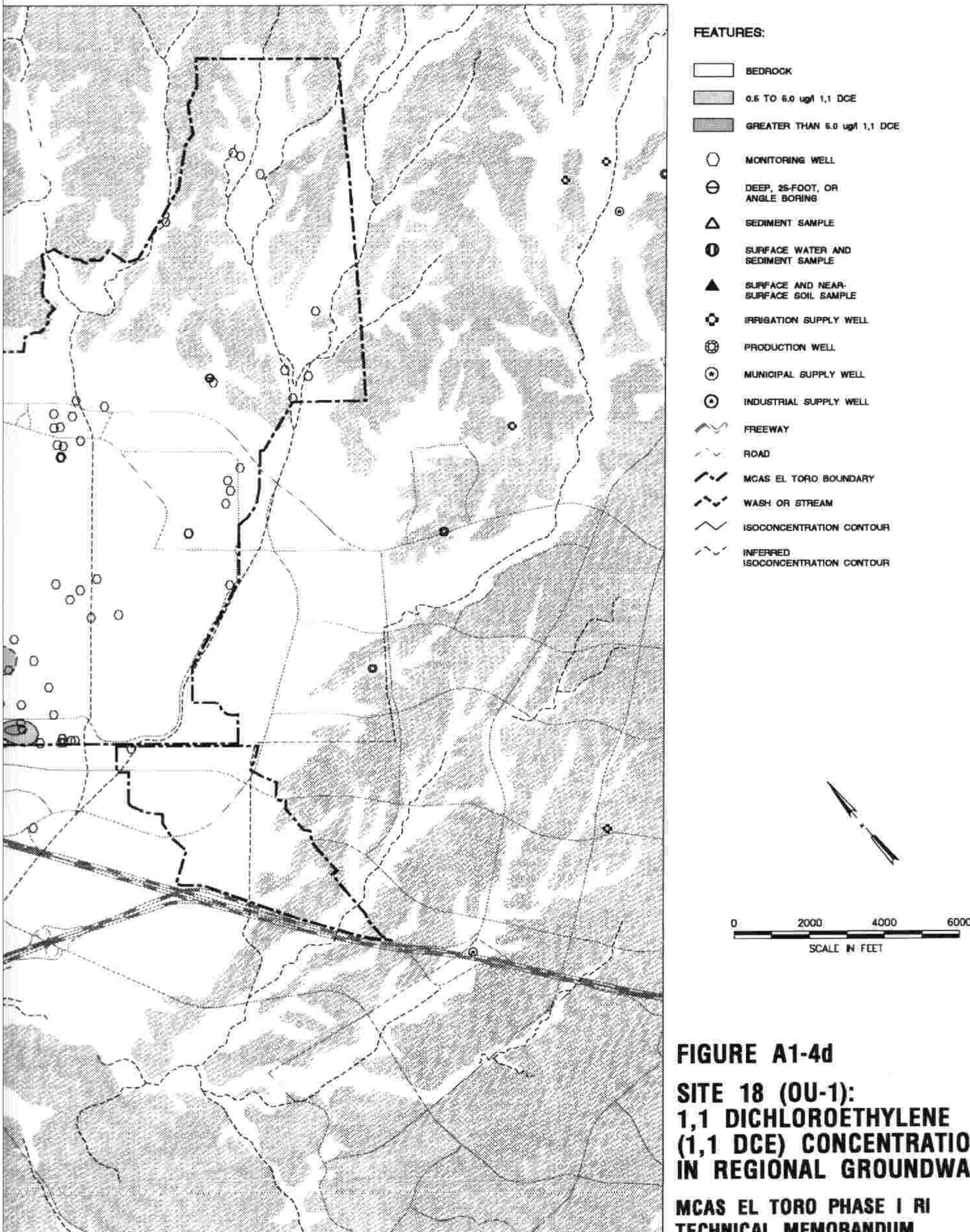

FIGURE A1-4d

SITE 18 (OU-1): 1,1 DICHLOROETHYLENE (1,1 DCE) CONCENTRATION IN REGIONAL GROUNDWATER

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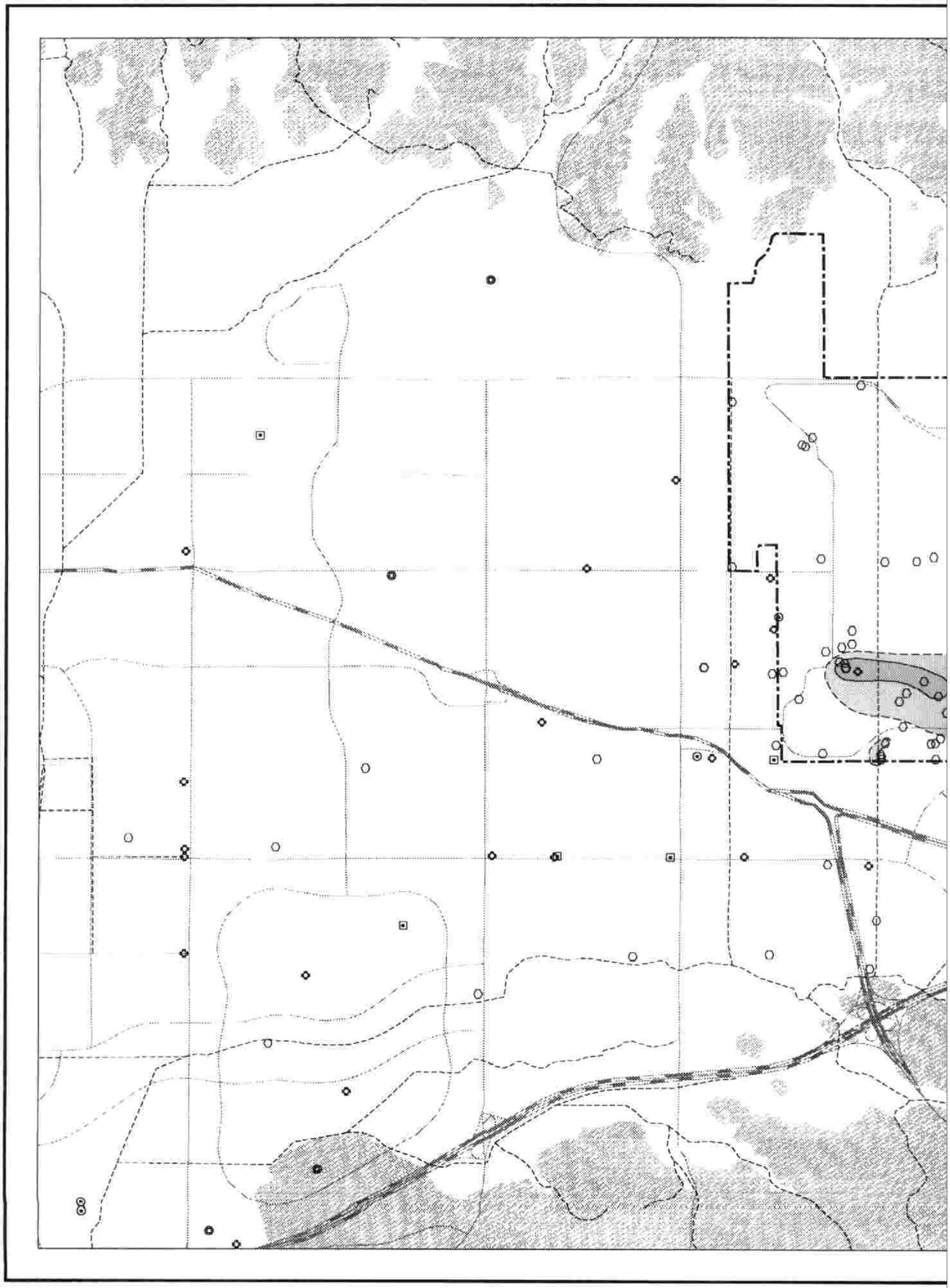

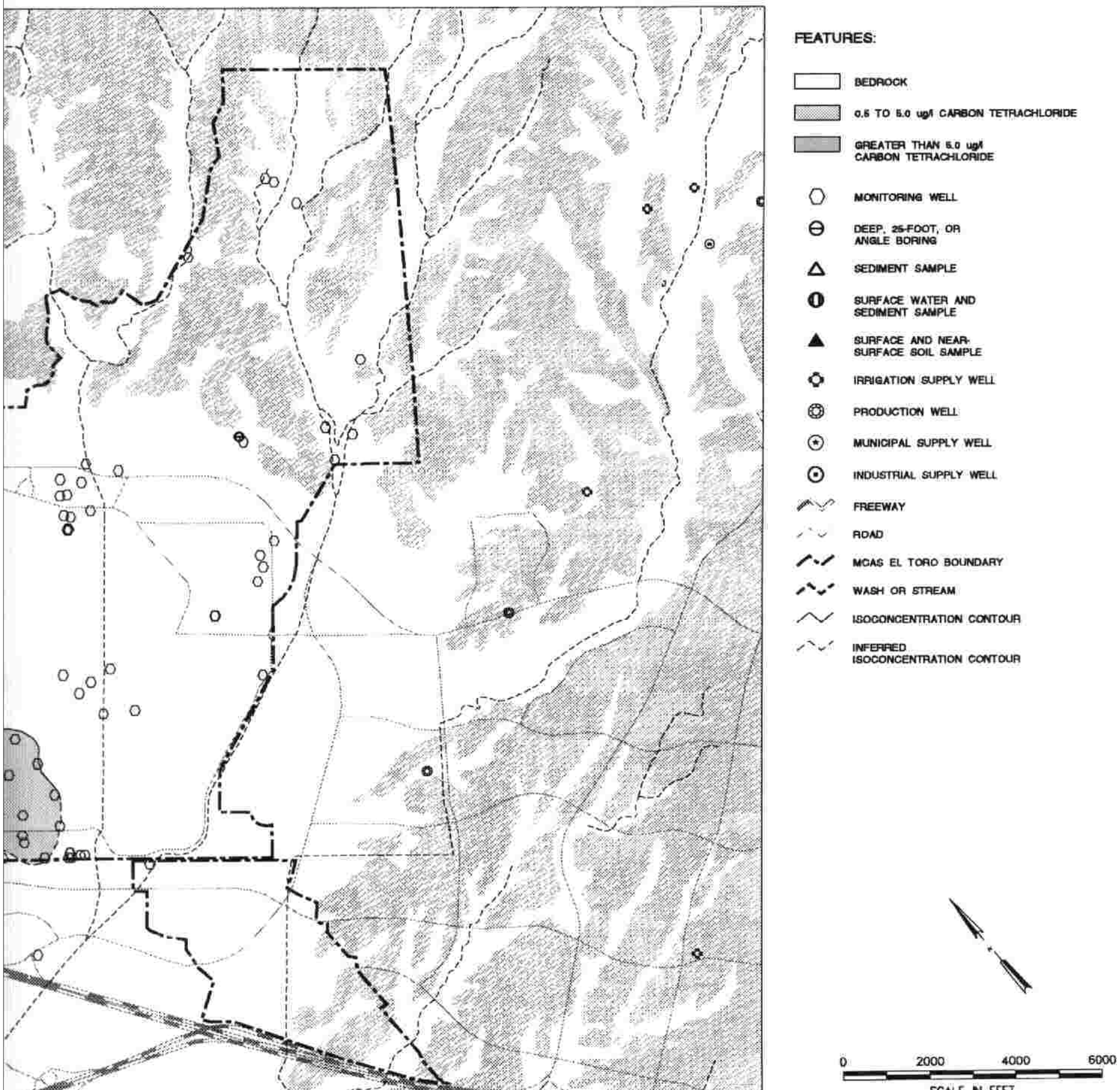

FIGURE A1-4e

SITE 18 (OU-1): CARBON TETRACHLORIDE CONCENTRATION IN REGIONAL GROUNDWATER

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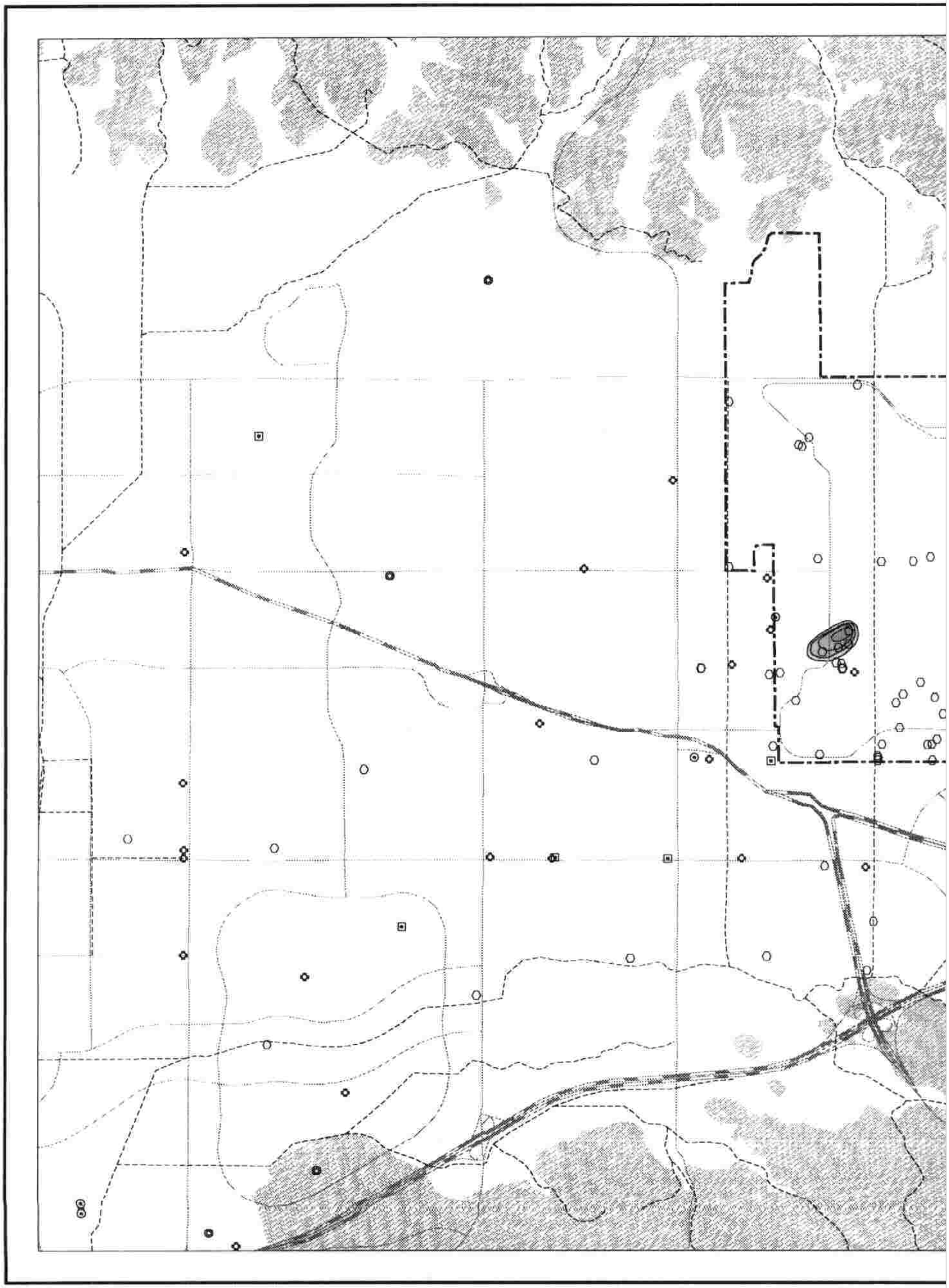

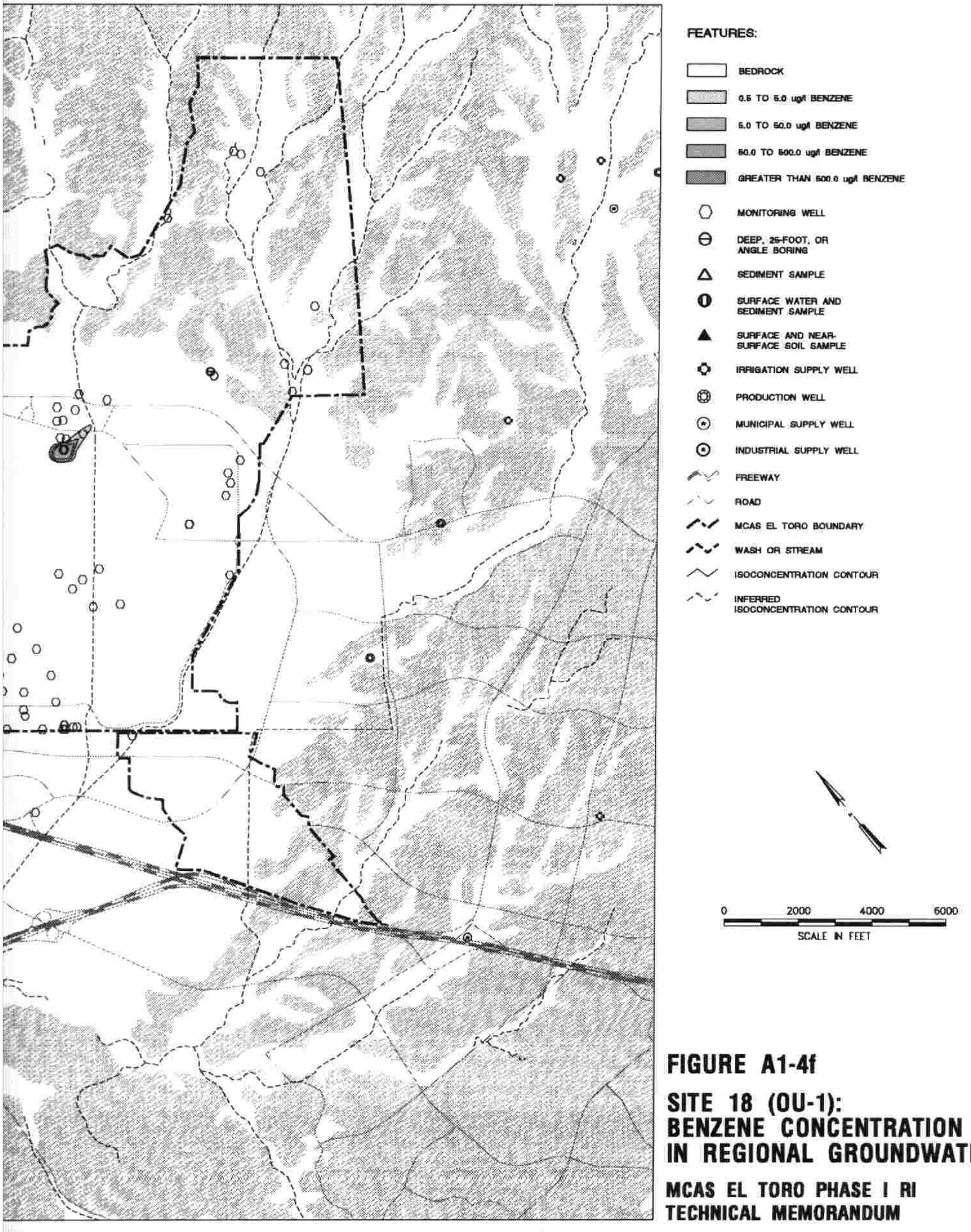

FIGURE A1-4f

SITE 18 (OU-1): BENZENE CONCENTRATION IN REGIONAL GROUNDWATER

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information collected during the RI. The pertinent wells are primarily those with the letter designations "MCAS" (because they were constructed to monitor contamination near MCAS El Toro) and "TIC" (The Irvine Company).

A1.1 Groundwater Field Investigation

The groundwater field investigation of Site 18 consisted of drilling, completing, and testing the water quality in 6 well clusters (each consisting of two to five wells), 4 multiple-port (Westbay) wells, and 12 single-screen wells that are screened across the uppermost permeable zones. Only one round of groundwater sampling was completed prior to writing this report. All conclusions drawn from this data must be considered tentative until such time as the data from the second round of sampling has been evaluated.

A1.1.1 Vadose Zone and Saturated Zone Soils Sampling

Soil vapor headspace concentrations were measured on selected vadose zone soil samples collected during drilling from background monitoring wells. The concentrations of these headspace analyses from Site 18 wells (both above and below the groundwater surface), along with data from borings at other sites, are in Attachment 1 to Appendix B. No vadose zone soil samples were submitted for laboratory chemical analysis.

At least one soil sample below the groundwater surface in each well or well cluster was scheduled to be submitted for analyses of volatile organic compounds (VOCs) and total organic carbon (TOC). The sample was planned to be collected within the screened interval of the monitoring well, but was not collected for some of the mud-rotary-drilled wells, because it was not always possible to select the actual well screen interval while drilling was in progress. Table A1-1 is a summary of saturated formation VOC and TOC concentrations at all wells tested. The VOCs detected in saturated soils in the well screen intervals do not correlate with detected VOCs in groundwater, with the following exceptions:

- The two wells (18_BGMW03E, and 22_DBMW47) containing the second and third highest concentrations of TCE in groundwater at MCAS El Toro also have detectable concentrations of TCE in the saturated soil zone. The concentrations of TCE in soils and groundwater, respectively, are 19 ug/kg and 370 μg/L at 18_BGMW03E. The concentrations for TCE in soils and groundwater, respectively, are 6.0 ug/kg (estimated) and 1,000 μg/L at 22_DBMW47. At 09_DBMW45, however, the screen-interval soil has no detectable TCE, while the groundwater has 2,000 μg/L of TCE.

- The well screen interval soil sample in Well 13_UGMW32 contained and estimated 6.0 ug/kg, and the groundwater contained 730 μg/L benzene.

- Trace amounts of toluene occur in both the well screen interval soil sample and groundwater from Well 18_BGMW02D.

A1.1.2 Groundwater Sampling

The sampling locations and groundwater analyte groups for the Site 18 groundwater investigation are summarized in Table A1-2. The well locations, well construction details, pump installation records, and dates of groundwater sampling for the full suite of analyses for Site 18 wells are summarized in Table A1-3.

During the first few months of field work, samples of groundwater were collected during well development for analysis for volatile organic compounds (VOCs). A 48-hour laboratory turn-around time was requested for the sample analysis. Of the two dozen groundwater samples collected during well development from various sites (including 17 samples from Site 18 wells), the majority of the samples contained no detectable VOCs. It was suspected that agitation of the groundwater and introduction of air during well development tended to reduce VOC concentrations. Collection of water for full groundwater-quality analysis was also beginning at about the same time; thus, the program to sample groundwater during well development was terminated. Groundwater samples collected only for VOC analysis are not listed in Table A1-3; however, the sample numbers are listed in Table A1-2, and all analyses results are in the project database.

A1.2 Inorganic Groundwater Chemistry

Section 1.2 discusses field parameters and the concentrations of major ions, metals, cyanide, and gross alpha/gross beta particle activity.

A1.2.1 Field Parameters

The electrical conductivity, Ph, and temperature of groundwater samples were measured by the field staff during well development and well purging prior to water-quality sampling. The values obtained prior to collecting the groundwater sample from each well are given in Table A1-4. Temperature data for low yielding wells should be used with caution. The water temperature sometimes increased during purging from these wells due to insufficient water volume and velocity to dissipate heat from the submersible pump motor. Field pH values ranged from 6.64 to 7.74. Conductivity ranged from 560 to 7000 micromhos per centimeter (μmhos/cm) at 25 degrees Celsius. Temperatures ranged from 19.5 degrees Celsius at Well 7, southwest of the station to 27.0 degrees Celsius in groundwater from Well 03-DGMW67. No apparent correlation between temperature and depth, pH and temperature, or pH and electrical conductivity was observed.

A1.2.2 Major Ion Chemistry

To evaluate general mineral water quality, groundwater was analyzed in the laboratory for the major cations and anions, total dissolved solids (TDS) and pH. As one check of the accuracy of general mineral analyses, the major anions and cations were converted from milligrams per liter to milliequivalents per liter (meq/L) and total anion and total cation concentrations in meq/l were calculated. Analyses with anion/cation balances within 5 percent were considered to be adequate for further analysis. The groundwater and surface-water analyses used for the Stiff-type diagrams and Piper diagrams are provided in Table A1-5. Stiff-type diagrams (Hem, 1985), modified to show potassium and nitrate concentrations separately, were plotted using the converted data. The diagrams are in Appendix J.

OCWD studies (Herndon and Reilly, 1989; Herndon, 1990) concluded that groundwater in the Irvine Subbasin consists of three zones of chemically distinct groundwaters known as hydrogeochemical facies, as previously discussed in Subsection 1.3.8. Two facies (a shallow and deep) occur in the alluvial-flood plain aquifer, and the third facies occurs beneath the main aquifer in the semiconsolidated, low-permeability (bedrock) sediments. An facies intermediate between Facies 1 and Facies 2 may exist, as indicated in (Table A1-6).

Plate J-1 (Appendix J) shows Stiff-type diagrams at cluster or multiple-port wells in the Irvine Basin. The shape of a Stiff-type diagram reflects the relative major ion content in milli-equivalents per liter (meq/L) and the size is proportional to the TDS. With this method of displaying the data, the separate hydrogeochemical facies can be easily identified. Plate J-1 shows the change in major-ion chemistry with depth in groundwater. The change is most pronounced in the area west of MCAS El Toro. Stiff-type diagrams for selected wells that penetrate no more than 40 feet into the uppermost aquifer on MCAS El Toro or are screened over a thick section of aquifer off-Station are shown on Plate J-2.

Total Dissolved Solids. TDS in shallow groundwater on-Station ranges from less than 500 mg/L in the eastern corner of the Station near the foothills to greater than 2,000 mg/L beneath the western corner of the Station (Figure A1-2). OCWD data from wells in the headwaters of the drainages that flow through MCAS El Toro indicate that high TDS concentrations are naturally occurring. In 1983, OCWD drilled three wells in the Santa Ana Mountains. Two wells (30 and 50 feet deep) were in the headwaters of Agua Chinon Wash and one well (50 feet deep) was drilled in the headwaters of Bee Canyon. Groundwater from these wells was sampled and analyzed five times from April 1993 to March 1984.

TDS in groundwater from the Agua Chinon wells averaged 3,000 mg/L in the 50-foot deep well and about 3,400 mg/L in the 30-foot deep well. Average TDS in the five groundwater samples from Bee Canyon Wash was 3,536 mg/L (Banks, 1984).

Calcium. Calcium concentrations in groundwater increase across MCAS El Toro from the east to the northwest and west. Concentrations in groundwater from wells at Sites 1, 2, 3, 4, and 17 are generally less than 100 mg/L. Concentrations in groundwater from Sites 5, 7, 8, 9, 10, 19, and 21 are generally between 100 and 200 mg/L. Calcium concentrations at Sites 12, 14, and 20 are greater than 200 mg/L, and appear to be typical of regional groundwater quality. A high-concentration anomaly occurs in groundwater at Sites 13, 15, and in upgradient wells at Sites 3 and 16. However, calcium concentrations of up to 5,000 mg/L have been measured in other wells investigated by OCWD.

Sodium. Sodium concentrations in groundwater also increase from the east to west, although the pattern is not as uniform as with calcium. The highest concentration of sodium in the uppermost aquifer is less than 250 mg/L. No anomalies in sodium concentrations can be detected. In the OCWD wells (described in the subsection on TDS) sodium is the predominant cation in groundwater samples. Sodium concentrations ranged from 470 to 610 mg/L in Agua Chinon groundwater and from 490 to 610 mg/L in Bee Canyon Wash (Banks, 1984).

Magnesium. The increase in magnesium appears to roughly parallel the increase in calcium. A band in a north-south zone with magnesium concentrations above 100 mg/L occurs in the northwest quadrant of the Station. Magnesium, along with calcium, is a common constituent in limestone, dolomitic limestones or siltstones, and ferromagnesium minerals contained in volcanic rock.

Bicarbonate. Bicarbonate predominates in the uppermost groundwater underlying about half of the Station (Plate J-2). In general, groundwater dominated by bicarbonate has TDS of less than 1,500 mg/L and has calcium or sodium as the dominant cation. The highest field values of pH was about 7.5; thus, no carbonate was detected in any of the groundwater samples.

Sulfate. Sulfate occurs primarily in the uppermost portion of the aquifer. High concentrations were documented in two distinct on-Station areas, as shown on Figure A1-3. The eastern high-sulfate area with concentrations of sulfate lies between Borrego Canyon and Bee Canyon washes. The northwestern area, with concentrations of sulfate greater than 1,000 mg/L, lies along the edge of the Station. This contouring was done on the basis of one round of sampling. The northwestern sulfate area coincides with an area of high concentrations of calcium and magnesium in groundwater.

Sulfate appears to be of natural origin. In the OCWD wells drilled in the headwaters of Bee Canyon and Agua Chinon washes, sulfate concentrations ranged from 950 to 1300 mg/L in the 15 groundwater samples (Banks, 1984). In addition, Tan et al. (1984) described locations in the northern half of the El Toro U.S. Geological Survey quadrangle where "mineral water" was used for spa circa 1910, or sold as bottled water. Groundwater from one source is described as ". . . the calcium sodium sulfate type with a total dissolved solids content of 2,390 mg/L and a pH of 7.3."

Chloride. In the uppermost portion of the aquifer, chloride is generally combined with calcium and contains high sulfate concentrations. The groundwater in the shallow well in Bee Canyon reported by Banks (1984) has high chloride as well as high sulfate. Chlorides are lower in the Agua Chinon drainage wells. In the semiconsolidated, low-permeability sediments (bedrock) beneath the usable aquifer beneath the Tustin Plain, chloride is combined with sodium.

Nitrate. Nitrate, reported as mg/L of nitrogen (N), occurs consistently at levels greater than the MCL of 10 mg/L beneath the Station with two exceptions: the foothills in the north corner (Sites 1, 2, and 17) and the southeast edge of the

Station. In the 1983-1984 OCWD groundwater evaluation, nitrate (as N), as nitrogen, varied from 0.9 to 7.5 mg/L in the shallow Agua Chinon well; the maximum concentration was 0.2 mg/L in the 50-foot deep well. The maximum concentration of nitrate (as N) was 2.7 mg/L in the Bee Canyon groundwater (Banks, 1984).

The highest concentration of nitrate (as N) on Station is 63.4 mg/L in groundwater at Site 15. At Multiple-port Well 9 (off-Station to the southwest), the high nitrate concentration (60.2 mg/L at 59 to 69 feet bgs) is limited to the uppermost portion of the aquifer. At Well Cluster 19 (in the SeaTree nursery northwest of MCAS El Toro), groundwater samples contain high nitrates (53.6 and 66.7 mg/L as N) from screens set from 98 to 138 feet bgs and 150 to 170 feet bgs, respectively.

Nitrate concentrations appear to be caused by agricultural activities that occurred prior to opening of MCAS El Toro. High nitrate concentrations have been documented by OCWD in almost all shallow groundwater to the northwest and west of MCAS El Toro. Nitrates also occur in deeper groundwater in a limited area (OCWD & B&V, 1993). Banks (1984) reported that the areas of high nitrates can be attributed to a variety of causes: nitrate fertilizers, organic wastes from farm animals, and 15 years of unsewered development in areas previously used for agriculture. Irrigated agriculture and irrigation of the golf course are occurring now on-Station. However, these areas overlie groundwater that has some of the lowest on-Station nitrate concentrations.

A1.2.3 Metals

Three metals (arsenic, cadmium, and selenium) were detected in concentrations above the drinking water MCLs (Table A1-7). Arsenic was detected in groundwater from Well 18_BGMW19B (SeaTree Nursery well cluster, screened from 400 to 420 feet bgs) at a concentration of 122 μg/L (MCL = 50 μg/L). Cadmium (MCL = 5 μg/L) was detected at Well 18_BGMW05D (the 6-inch diameter pumping test well west of Agua Chinon Wash) at a concentration of

118 μg/L. The other detections of cadmium above the MCL were in groundwater in wells in the Well Cluster 1, located near Site 4. Concentrations were 6.2 μg/L in groundwater from 18_BGMW01D (screened at 242 to 262 bgs) and 7.4 μg/L in groundwater from Well 18_BGMW01C (screened at 330 to 350 feet bgs).

Selenium, with an MCL of 10 μg/L, was detected above the MCL in groundwater from all wells drilled during the Phase I RI with the exception of wells at Sites 1 (EOD Range), 2 (Magazine Road Landfill), and 5 (Perimeter Road Landfill) and background Well 18_BGMW22 (on Bee Canyon Wash, upgradient from the Station). Concentrations range to greater than 100 μg/L. The concentrations in shallow groundwater generally follow the TDS contours, with the highest concentrations along the northwest quadrant of the Station. An isolated high concentration of selenium (34.2 μg/L) occurs in groundwater from Well 18_BGMW24, a background well near Site 1 in the upgradient area of Borrego Canyon Wash. The selenium concentrations are consistent with OCWD findings, as documented by Banks (1984, pages 6-14 and 6-15):

> Selenium concentrations in excess of the water quality objective . . . correspond with the areas of highest TDS. . . Historically agricultural land use in the area suggest that insecticide sprays may be a source of high selenium. However, a more likely source of selenium in the Area may be high selenium soils or geologic structure in the Santa Ana Mountains bordering the north portion of the Area. Selenium is similar to sulfur in some respects and has a similar occurrence in sedimentary rocks such as shales, siltstones, mudstones and evaporite deposits.

A1.2.4 Cyanide

Cyanide was detected in groundwater from nine wells. The highest groundwater concentration was estimated at 5.5 μg/L in Well 07_DBMW62. The concentration of cyanide was 21.4 μg/L in one potable water sample from the fire hydrant at Site 3. Cyanide in the equipment blank (rinse water) from the Westbay equipment after collection of the groundwater sample from the uppermost screen was reported at a concentration of 15.4 μg/L cyanide. However, the groundwater samples collected using the equipment before and after the equipment blank contained no detectable cyanide.

A1.2.5 Gross Alpha and Beta Particle Activity

Gross alpha and beta particle activity in groundwater were not analyzed at Site 18 wells. Analyses for gross alpha and beta particles were scheduled for groundwater from the EOD Range (Site 1), the landfill sites (Sites 2, 3, 5, and 17), and the deep borings/monitoring wells at Sites 9 and 22. Two additional groundwater samples (from wells 07_DGMW71 and 19_DGMW85) were also analyzed for gross alpha and gross beta particles. Each groundwater sample was filtered in the field prior to placing it in an acidified container. Results are summarized in Table A1-8.

Gross alpha concentrations are slightly above the EPA Primary MCLs of 15 pico Curies per Liter (pCi/L) in two downgradient wells at Site 2 and in Well 03_DBWM40. Groundwater in one downgradient well at Site 5 (Well 05_DGMW67), both gross alpha and gross beta exceeded the MCL of 15 Pci/L and 50 Pci/L, respectively. Gross alpha is used only as a screening tool; further analysis of samples with concentrations above 15 Pci/L is needed to confirm compliance or non-compliance with MCLs. Gross alpha activity is typically from natural sources; high gross beta concentrations are also common in areas underlain by shales or siltstones or in the sediments derived from them.

A1.3 Synthetic Organic Compounds

Synthetic organic compounds were analyzed in 137 groundwater samples (including 13 duplicate samples), approximately 50 trip blanks, 26 equipment blanks (rinsates), 14 potable water samples, and 1 deionized water sample. The groundwater samples consisted of at least one water sample from each of the 95 newly drilled wells (with 124 separate well screens), and at least one sample from the previously existing groundwater monitoring wells on-Station (designated with PS-, DW-, and DW- prefixes). Synthetic organic groups of chemicals analyzed were VOCs, semivolatile organic compounds (SVOCs), pesticides and PCBs, herbicides (with the exception of groundwater samples from Wells 6, 7, and 10), and hydrocarbons. Trip blanks were analyzed only for VOCs.

A1.3.1 Volatile Organic Compounds (VOCs)

The Phase I Remedial Investigation *Work Plan* (1991) listed 17 VOC contaminants of concern. Twenty-four of the 34 VOC analytes were detected in at least one of the groundwater and quality control samples collected during the Phase I RI. Table A1-9 summarizes those chemicals of concern and the number of groundwater samples in which each were detected. Each of these compounds is discussed below. Maps showing concentrations of VOCs in groundwater from July 1992 through January 1993 were contoured using the highest observed concentrations at any depth at each well or well cluster/multiple-port well location (Figure A1-4a through A1-4f). Contour concentrations are 0.5, 5.0, 50, and 500 μg/L of each VOC. Contour lines are dashed where inferred.

The earliest OCWD water quality data are from 1985; the most recent are from December 1992. Where appropriate, this Technical Memorandum has used OCWD data to complement data collected specifically for the Phase I RI. This RI has used only the most recent OCWD data (from July 1992 or later) for any given well or well interval. Forty-six OCWD analyses are included in the discussion below.

A1.3.1.1 Trichloroethylene (TCE)

MCAS El Toro was originally listed on the NPL because of the VOC contamination observed along the Station perimeter and in wells located west of the Station. Concern has mainly focused on TCE, which has been the most widespread and most highly concentrated VOC. The Phase I RI has identified two areas of TCE concentration in groundwater at MCAS El Toro; TCE was detected at 49 locations beneath the Station. OCWD reported TCE in 21 samples of groundwater collected off-Station since July 1992. The main area of TCE contamination (Figure A1-4a) occurs in the southwestern portion of the Station. A minor source is the Magazine Road Landfill (Site 2). TCE originating at this landfill may be a source of the low concentrations of TCE in groundwater observed at Site 5 (Perimeter Road Landfill) and Site 19 (ACER Site).

The main area of TCE contamination observed on-Station occurs in a broad region in the southwestern portion of MCAS El Toro. Groundwater collected at the following sites have shown detectable levels of TCE: Site 7 (Drop Tank Drainage Area 2); Site 8 (DRMO Storage Area); Site 9 (Crash Crew Pit No. 1); Site 10 (Petroleum Disposal Area); Site 12 (Sludge Drying Beds); Site 14 (Battery Acid Disposal Area); Site 21 (Materials Management Group); and Site 22 (TAFDS Area).

Site 7 appears to define the upgradient extent of the contamination on the northeast, because samples collected from three wells located on the upgradient edge of this site have not contained detectable levels of TCE. Similarly, the Agua Chinon Wash appears to define the upgradient extent of the contamination on the south, because wells sampled to the north of the wash have shown detectable levels of TCE, while Well 18_BGMW14, located just to the south near Borrego Canyon Wash, has not shown a detectable concentration of TCE. Groundwater contamination on-Station also appears to be confined to the uppermost permeable zone. Samples from cluster wells constructed in the main zone of contamination all confirmed this observation, except for Well 18_DGMW4B, which is screened in the second permeable zone at a depth of 190-210 feet bgs. A sample from this well, located near Bee Canyon Wash downgradient of the suspected source area, contained TCE at a concentration of 14 μg/L.

The highest concentration of TCE was found in Well 9_DBMW45 at Site 9, where a sample contained 2,000 μg/L of TCE. Other wells nearby that contained TCE in excess of 100 μg/L are Well 9_DGMW75 (270 μg/L), Well 7_DGMW72 (120 μg/L), Well 8_DGMW73 (140 μg/L), Well 8_DGMW74 (150 μg/L), and

Well 18_BGMW3E, located between Sites 7 and 10 (370 μg/L). No soil sample was collected at any of the sites near the main body of TCE-contaminated groundwater on-Station that contained detectable levels of TCE, except for a sample collected a depth of 110 feet (4 feet above the water table) in the borehole for Well 7_DGMW71; the TCE concentration in this sample was 74 ug/kg. Low concentrations of TCE were detected in the vicinity in soil samples collected during the RFA.

The lack of detected TCE in soil samples implies that the actual source of the TCE has not been located. However, even though a concentration of 2,000 μg/L is not close to the aqueous solubility of TCE, it is sufficiently elevated to suggest the presence of a nearby source. There is nothing in the record or sampling data that would implicate Site 9. Historical evidence for potential TCE releases as part of dust suppression at Site 10 also do not appear to be the source of TCE in groundwater for several reasons:

- The dust suppression was typically done with waste oil, and TCE is only a hypothesized potential compound that might at times have been contained in the oil mixture.

- A significant fraction of TCE would have evaporated during spraying due to volatilization from the high vapor pressure of TCE before infiltration as free product.

- Spraying does not typically supply a sufficient volume for significant infiltration through the vadose zone (approximately 100 feet thick in this area).

Although Site 7 was not originally considered to be a source area for VOCs, TCE concentrations detected in wells downgradient from Site 7 and upgradient from Sites 9 and 10 suggest that TCE may have originated in this area. This is consistent with the historical record, which indicates that industrial maintenance and repair activities have occurred at this site over the years.

A secondary concentration of TCE in this area was detected in wells in the vicinity of Site 8, which is cross-gradient to contamination located near Sites 7, 9, 10, and 22. Samples collected from the two downgradient wells at this site contained TCE at 140 μg/L and 150 μg/L. However, the upgradient wells 8_UGMW29 and 18_BGMW5D also contained TCE at 20 μg/L and 39 μg/L, respectively. In addition, Well PS-3, located just southwest of Site 8 along the Station perimeter, contained TCE at 64 μg/L.

These data imply that Site 8 is not the source of this detected TCE. The actual source may lie upgradient at the Motor Pool south of Site 8; or the source may be the Agua Chinon Wash, as suggested in previous investigations. Yet another possibility is that contaminants have drawn to this area from the Site 7 area in response to occasional pumping of an irrigation well south of the station. Data collected during the aquifer test at Well 18_BGMW14 indicate the possible presence of an unidentified irrigation well in this area.

Any explanation for the limited concentration of TCE detected in soil samples and the relatively high concentrations detected in shallow groundwater must be speculative at this time. Often when residual solvents exist at depth, they have been introduced into the subsurface via releases of a considerable volume of solvents over a long term. The TCE may have been released into the subsurface soil through disposal pits or depressions, or a leaking line, sump, or underground tank. These would have provided a sustained head over a period of time. Conversely, smaller uncontrolled releases of solvents may have short-circuited to depth by movement through an open, continuous conduit. For example, OCWD data suggests that there may be an abandoned well in the vicinity of Site 7.

Regardless of the pathway to depth, upon reaching groundwater, aqueous-phase TCE would be subject to downgradient adjective and dispersive transport, primarily in the lenses of highest permeability. Movement would likely occur at less than the average linear groundwater velocity due to retardation (sorption, biodegradation, diffusion into low-permeability lenses, etc.).

Data indicate that the TCE seems to be moving in a northwesterly direction generally consistent with the regional groundwater gradient. The TCE is drawn down into deeper zones as the lenses of high-permeable materials becomes thicker at depth toward the west, and in response to vertical gradients induced by operating irrigation wells. It is important to realize that the on-Station distribution of VOC contamination is based on data collected from only one groundwater sampling event. Future sampling events will further verify and characterize the nature and extent of the contamination.

A1.3.1.2 Tetrachloroethylene (PCE)

Two areas with PCE (also called tetrachloroethene or perchloroethylene) in groundwater underlie MCAS El Toro. As shown on Figure A1-4b, the most extensive area of PCE occurs beneath the southwestern portion of MCAS El Toro. The most upgradient detection is in Well 18_BGMW05D, west of Agua Chinon Wash. The area with detectable PCE concentrations extends beneath Sites 7, 8, 9, 10, 12, 21, 22 and off-Station. The data suggest that there may be two sources, one along the southwestern border in the vicinity of Site 8 (DRMO Storage Yard), and one more in the center of the southwest quadrant (Sites 7, 9, 10, and 22). The highest PCE concentration (58 μg/L) is in groundwater from Well 18_PS3, a well southwest of Site 8 (DRMO Storage Yard).

The second PCE area is downgradient from Site 2 (Magazine Road Landfill). PCE was detected at Site 5 (Perimeter Road Landfill) and Site 19 (the ACER Site). The highest concentration of PCE (8.0 μg/L) is in groundwater from Well 02_DGMW60, the most upgradient well. The concentration of PCE is at the detection limit (1 μg/L) in groundwater from the upgradient well and the deep boring well at Site 19 (ACER Site). PCE was detected in groundwater both in Well 18_BGMW02E, (between Sites 5 and 19) screened at 198 to 218 feet bgs, and in Well 18_BGMW02A, screened from 462 to 482 feet bgs. One of the samples was at the detection limit of 1.0 μg/L; a duplicate of this sample from 18_BGMW02E and the sample from the deeper well were tentatively detected below the CRDL. The two wells with screens between these two zones contained groundwater with no detectable PCE. Future groundwater monitoring is needed to provide additional information.

A1.3.1.3 1,2-Dichloroethylene (Total)

Table A1-9 lists both the trans- and cis- isomers of 1,2-dichloroethylene (also known as 1,2-dichloroethene, or 1,2-DCE). The two isomers were not separated in the laboratory analyses (nor in the OCWD data); thus, all reporting is in total 1,2-dichloroethene. 1,2-DCE appears to extend from the western corner of MCAS El Toro to the monitoring well 18_MCAS-07 (Figure A1-4c). This area extends from Well 18_BGMW04B, which also serves as a downgradient well for Site 12 (Sludge Drying Beds). A smaller total 1,2-DCE area also extends downgradient from Site 2 (Magazine Road Landfill). A third area occurs along the southern part of the southwest border of the Station. The wells affected do not pinpoint a specific site as the source, but the area is south of Site 8. An isolated occurrence of low levels of 1,2-DCE is at Well 09-DBMW45. 1,2-DCE is a degradation product of TCE and PCE.

A1.3.1.4 1,1-Dichloroethylene

Two areas with detectable concentrations of 1,1-dichloroethylene (also called 1,1-DCE) occur beneath MCAS El Toro (Figure A1-4d). This compound has not been reported from groundwater samples collected at wells off-Station. The first area underlies Sites 7, 9, and 10. The highest concentrations of 1,1-DCE are from groundwater in Well 09_DBMW45, where the highest concentrations of TCE in groundwater was detected. Duplicate samples indicated concentrations of 2.0 and 4.0 μg/L. The second area appears to be associated with Site 8 (DRMO Storage Yard); the highest concentration of 1,1-DCE (8.0 μg/L) is in groundwater from Well 08_DGMW73. These areas correspond with the highest concentrations of TCE and PCE in groundwater, indicating that 1,2-DCE and 1,1-DCE may be biodegradation products.

A1.3.1.5 Carbon Tetrachloride

Carbon tetrachloride occurs in groundwater from 14 wells, all in the southwestern portion of the Station (Figure A1-4e). The highest concentrations (19 μg/L, with an MCL of 0.5 μg/L) occur in groundwater from Well 14_DBMW50 (Battery Acid Disposal Area) and in the uppermost two of the DW cluster wells next to Site 14. No carbon tetrachloride was detected in the three deeper wells in the DW Cluster or in the nearby pumping well (TIC-55). The three monitoring wells and the pumping well are screened at depths greater than 300 feet bgs. No carbon tetrachloride has been in detected off-Station. The MCAS El Toro Perimeter Investigation Interim Report (JMM,1989) identified carbon tetrachloride in the same two DW wells, and in PS-1, PS-3, PS-6, and PS-8. In this sampling round, groundwater from wells PS-6 and PS-8 contained 1.0 and 3.0 μg/L of carbon tetrachloride, respectively. Carbon tetrachloride was not detected in groundwater from Well PS-3; groundwater in Well PS-1 was not analyzed.

A1.3.1.6 Chloroform

The compound that was detected most often after trichloroethylene in groundwater beneath MCAS El Toro was chloroform. Chloroform is a trihalomethane (common in potable water). During chlorination of drinking for disinfection, chlorine reacts with dissolved organic matter (such as fulvic and humic acids) to form trihalomethanes. The maximum contaminant level (MCL) for chloroform is 100 μg/L. The health-based guidance level for human ingestion, however, is 5.7 μg/L. Chloroform was detected in 37 groundwater samples, with the highest value at 12 μg/L in well 14_DGMW79. Sites 2, 3, 7, 8, 9, 12, 14, 17, 18, and 21 contain low-level detectable amounts of chloroform. Groundwater from wells at Site 2 (7.0 μg/L), Site 8 (maximum concentration 9 μg/L), Site 14 (cited above), and Site 17 (7 μg/L) exceeded the health-based guidance level.

Chloroform, whoever, was detected at concentrations of up to 14 μg/L in potable water from the fire hydrants used by the drilling contractor for makeup water. It is possible that chloroform detected in groundwater samples is the result of water used during drilling operations. More details on this topic are in Subsection 1.3.1.

A1.3.1.7 Benzene

Benzene occurs in two locations beneath MCAS El Toro (Figure A1-4f). Both areas are associated with TFH-diesel and TFH-gasoline in groundwater, although no free product was encountered in any well drilled for the Phase I RI. The MCL for benzene is 1 μg/L. No benzene concentrations have been detected in groundwater off-Station.

The first area of contamination is defined by groundwater in four wells in Site 13 (Oil Change Area) and Site 15 (Suspended Fuel Tank Area). Depth to water in this area is 125 to 140 feet. The highest concentration (730 μg/L) is from Well 13_UGMW32, which is cross-gradient from the site because it was drilled prior to recognizing the direction of groundwater flow. Benzene concentrations in groundwater from the other three wells at Sites 13/15 ranged from 23 to 120 μg/L. Benzene was not detected in soil samples from borings drilled directly into the sites being investigated. The Site 13 map (Appendix B13) shows a buried tank farm (Tank Farm 2) next to Site 13.

The northern area of benzene contamination is defined by benzene in groundwater from two wells: the upgradient well at Site 4 and the uppermost screened interval in the Well Cluster 1 to the south of Site 4. The concentrations of benzene are 3 μg/L in Site 4 Well 04_UGMW63 and 270 μg/L in Well 18_BGMW01E. Depth to water is 220 feet. Well 04_UGMW63 is adjacent to Tank Farm 5, an active tank, and Well 18_BGMW01E is just south of Tank Farm 5.

A1.3.1.8 Other VOCs

1,1,2-Trichloroethane (1,1,2-TCA) was detected in two Site 18 wells (PS-3 and the pump test well 18_BGMW05D). Concentrations were 0.9 and 0.5 μg/L, both below the CRDL of 1 μg/L; The third 1,1,2-TCA concentration (2.0 μg/L) was in groundwater from Well 08_DGMW73.

Several VOCs were not detected in the groundwater samples, or were detected in low concentrations: acetone; 1,1,2-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; methyl ethyl ketone (2-butanone); chlorobenzene; ethyl benzene; and xylenes. Acetone and 2-butanone are demonstrated laboratory contaminants for Phase I samples.

A1.3.1.9 Analysis of Water Used for Drilling and Cleaning

As described in the *SAP*, potable water from on-Station fire hydrants was used during the Phase I RI for cleaning drilling equipment and for washing soil samplers. Final rinsing of sampling equipment was with de-ionized water delivered to the field in 5-gallon plastic containers. Pumps and ancillary equipment (owned by Beylik and used to develop wells) were cleaned with potable water and rinsed with de-ionized water. As part of the quality assurance program, potable and deionized water was tested for the same parameters as the Site 18 well samples. One sample of deionized water, seven samples of potable water (from three different fire hydrants), and six samples of potable water after it had been placed in rig- or truck-mounted water supply tanks were analyzed.

In the 14 samples analyzed, trihalomethanes (THMs) were the most common VOC, as summarized below. The minimum THM concentrations were all from the analysis of the de-ionized water.

Compound	Potable and De-ionized Water (14 Samples)				Groundwater (117 Samples)	
	Number of Detects	Maximum Value, Hydrants, $\mu g/L$	Maximum Value, Tanks, $\mu g/L$	Minimum Value, ($\mu g/L$)	Number of Detects	Maximum Value, ($\mu g/L$)
Bromodichloromethane	14	22	17	4.0	10	11
Bromoform	13	10	7.0	0.9	1	2.0
Chlorodibromomethane	14	27	19	4.0	9	11
Chloroform	14	14	9.0	4.0	38	12

In addition to THMs, carbon disulfide was detected in four samples of potable water and in one trip blank; the highest concentration was 62 $\mu g/L$. The compound was detected in seven groundwater samples; the highest concentration was 8.0 $\mu g/L$. Five of the seven detected carbon disulfide concentrations were from wells drilled using the mud rotary method of drilling, in which potable water is introduced to the well. Acetone was detected in four samples from groundwater (maximum concentration, 51 $\mu g/L$) and in one sample from a tank (6.0 $\mu g/L$). All groundwater samples containing acetone were from wells drilled using a mud rotary rig.

A1.3.2 Hydrocarbons (TRPH, TFH)

Hydrocarbons were analyzed in groundwater from all wells and intervals tested during the RI. In the 137 samples tested, no total recoverable petroleum hydrocarbons (TRPH) were detected in any groundwater. The same samples were analyzed for TFH-gasoline and TFH-diesel; the detected concentrations are summarized in Table A1-10.

TFH-gasoline was detected in 11 samples (9 wells, 2 duplicates), from six sites. At Site 4 and the nearby Site 18 well, 18_BGMW01E, TFH-gasoline in groundwater ranged from 77.7 to 1,980 $\mu g/L$. At contiguous Sites 13 and 15, TFH-gasoline in groundwater ranged from 58.9 to 1,690 $\mu g/L$. At Sites 9 and 22, TFH-gasoline ranged from 58.9 to 250 $\mu g/L$. Gasoline was also detected in groundwater from the most shallow screen at Multiple-port Well 18_BGMW09; the well is approximately 1/2 mile southwest of the Station and shows no volatile organic compound (VOC) contamination.

Diesel was also detected in the Site 4 wells, the Sites 13 and 15 wells, the DW series wells (drilled previously near Site 14), and various screens of three of the four multiple-port wells. Groundwater from Westbay Well 18_BGMP06 had no detections of TFH-diesel. Diesel was detected in two samples of potable water used for drilling, collected from truck-mounted water-supply tanks. One diesel concentration, at 4,110 μg/L, is the highest concentration for potable water or groundwater.

A1.3.3 Semivolatile Organic Compounds (SVOCs)

Water samples analyzed for SVOCs were analyzed for 34 compounds. Only five SVOCs (ethyl butyl phthalate, bis(2-ethylhexyl)phthalate, diethyl phthalate, dimethyl phthalate, and phenol) were detected, and these come from 19 samples (Table 1A-11).

Bis(2-ethyhexyl)phthalate was detected at 11 locations; the second highest concentration (22 μg/L) was from one sample of potable water from the fire hydrant at Site 3. Diethyl phthalate, at an estimated concentration of 3 μg/L, was detected only in Well 18_BGMW15, in the north corner of the Station. Benzyl butyl phthalate was detected at two sites and in potable water used for drilling by Rig 9. The concentration was 19 μg/L in groundwater from Well 10_DGMW77. The other two concentrations were below the CRDL. Dimethyl phthalate (concentrations ranging from 120 to 220 μg/L) was detected in the 18_DW well cluster. It is possible that this compound came from the pumps and drop pipe that were removed prior to sampling; phthalates are used to manufacture plastics and pump fluids. Low concentrations of phthalates are widely distributed in the environmental, and they are also common laboratory contaminants.

A1.3.4 Pesticides and Herbicides

Pesticides were detected in 8 of the 153 groundwater and potable water samples tested. One sample was a duplicate. Multiple pesticides were detected in groundwater from 03_DGMW64 and from 18_BGMW19E (Table A1-12). The latter well is in the SeaTree Nursery and obtains groundwater from the uppermost aquifer. In addition to groundwater samples, dieldrin was detected in the potable water hydrant at Site 3 (the primary source of drilling water), and endosulfan sulfate was detected in potable water from the fire hydrant near well 18_BGMW103. Potable water is supplied to MCAS El Toro from off-Station and is a combination of surface and well water.

Table A1-13 summarizes herbicide detections. Fourteen samples out of 92 contained detectable amounts of herbicides. Ten of the samples were of groundwater. Groundwater from Well 12_UGMW31 had a detectable concentration in 9 of the 11 analytes. Three samples of the water from the fire hydrant at Site 3 (the primary source of drilling water) contained detectable amounts of dalapon (ranging from 0.81 to 5.29 μg/L), and water used as makeup water at Drilling Rig 20 contained 2,4,5-T at a concentration of 0.71 μg/L.

No one sample of groundwater or potable water contained both herbicides and pesticides. Potable water from the fire hydrant at Site 3, which was analyzed monthly, contained an herbicide in three samples and a pesticide in one sample.

A1.4 Background Water Quality

The locations of Site 18 wells were chosen with two objectives in mind: to determine regional background groundwater quality, and to define the conceptual site model for the regional investigation by characterizing the source and transport pathways for groundwater contaminants continuous between sites. Shallow groundwater not affected by operations at MCAS El Toro is typified by the groundwater quality at Wells 18_BGMW15, 18_BGMW16, and 18_BGMW24. Stiff-type diagrams for these wells are shown on Plates J-1 and J-2 (Appendix J). Site 18 cluster wells with groundwater representing quality of groundwater at depth are 18_BGMW02B and 18_BGMW02D. Groundwater quality from Well 18_BGMW05A is typical of the water in the low-permeability semiconsolidated sediments that are below the base of the usable aquifer.

The major ions indicate that most of the groundwater is a mixed geochemical type in which no single cation or anion dominates (Plates A1-1a and A1-1b). Most of the water is a mixed calcium-sodium-magnesium-bicarbonate-chloride-sulfate type. There are a limited number of calcium-bicarbonate (Site 1), sodium-bicarbonate (Site 3) and calcium-chloride (Site 15) types of groundwaters.

The Piper diagrams (Appendix J) indicate that the cations are largely controlled by ion exchange of calcium and sodium. The groundwater has a trend toward calcium replacing sodium with depth and distance along groundwater flowpaths. There are only 14 groundwater samples in which calcium dominates (greater than 50 percent of the cation) and only 7 in which sodium dominates.

Anions are largely a mixture of bicarbonate and chloride with little sulfate influence. This suggests that the sediments do not contain significant amounts of iron sulfides, which are the common constituent in fine-grained marine sediments. Bicarbonate dominates 11 of the groundwater samples illustrated; chloride dominates 9 groundwaters, and sulfate dominates 6 groundwaters.

The diamond part of the Piper diagrams (Appendix J) indicates that there is a simple mixing of essentially two end-member water types: a sodium-bicarbonate type going through the dominant mixed water type to a calcium-chloride water type. An area the size of the Station typically contains a broader dispersion of water-chemistry types, particularly if contamination is both widespread and contains high concentrations of individual contaminants. This does not appear to be the case at MCAS El Toro. The simple mixing line, indicated by the Piper diagrams, suggests limited inorganic contamination both in nature and extent.

A1.5 Comparison of Groundwater Quality with Drinking Water Standards

Analyses of groundwater from OU-1 (Site 18) wells were compared to federal and California state drinking water standards: the EPA Primary Maximum Contaminant Level (MCL), the California MCL, the EPA Secondary MCL, and the California EPA -

Department of Toxic Substances Control (DTSC) Action Levels. A brief description of these standards is summarized below:

- EPA Primary MCL: Federally enforceable drinking water standard established for the health effects of contaminants
- EPA Secondary MCL: Nonenforceable standard based on aesthetic qualities of taste, color, and odor (includes chloride, sulfate, TDS, iron, and manganese)
- California MCL: Health-based drinking water standard enforceable at the State level
- DTSC Action Level: Nonenforceable levels at which DTSC strongly urges water purveyors to take corrective action to reduce the level of contamination in the water they supply (Action levels cease to exist when state MCLs are promulgated).

The most stringent federal/state standard was applied. In the presence of both an EPA MCL and a California MCL, the most stringent MCL was used. If neither an EPA or California MCL was available, the California State Action Level was used.

Applicable drinking water standards are listed in Table A1-14 along with the minimum and maximum concentrations of each detected chemical in groundwater. The groundwater analytes for all sites and wells that exceeded the MCLs are summarized by contaminant in Table A1-15, providing an overall summary of contaminants in groundwater beneath MCAS El Toro.

The primary inorganic contaminant, nitrate, appears to be from agricultural sources. The selenium appears to be a naturally occurring contaminant. The majority of the wells drilled during this project produced groundwater that could not meet drinking water standards because of selenium. Table A1-6 (presented previously) lists Site 18 wells drilled or sampled for the Phase I RI and the groundwater contaminants in those wells that do not meet drinking water standards. Comparable tables in each Section of Appendix B provide the information for wells drilled at Sites 1 through 10, 12 through 17 and 19 through 22. (No well was constructed at Site 11.)

A1.6 Suspected Source Areas of Groundwater Contamination

The major suspected source areas for the synthetic organic compounds, primarily VOCs, are in the group of sites between the runways in the southwestern area of MCAS El Toro (Sites 7, 9, 10, and 22) and Site 2 (Magazine Road Landfill). Table A1-16 summarizes data from RI/FS sites and offers an assessment on which sites appear to be contributing to OU-1 (Site 18) groundwater contamination, which sites do not appear to be contributing, and which sites have inconclusive data.

A1.6 Conclusions

The distribution of VOCs in groundwater indicates the presence of separate on-Station source areas. Two different groups of VOCs in groundwater are apparent.

- PCE-TCE Group: The first contaminant group incudes PCE, TCE, 1,2-DCE (total), 1,1-DCE, carbon tetrachloride, chloroform, and TFH-gasoline and TFH-diesel (PCE-TCE group).
- Benzene Group: The second contaminant group includes only benzene and TFH-gasoline and TFH-diesel (benzene group).

PCE-TCE Group. The PCE-TCE group of VOC contaminants is the major source of groundwater contamination. Three sources areas appear to be contributing to the regional groundwater VOC contamination:

- Sites 7/8
- Site 2
- Site 9/22

The broad area encompassing Sites 7, 9, 10, 22, and 8 appears to be the primary source area (Figures 6-1a and 6-1b). The highest concentrations of PCE (greater than 50 μg/L) are centered in the area encompassed by Sites 7 and 8, and the highest concentrations of TCE are centered in the area encompassed by Sites 9 and 22. Both of these centers coalesce, overlap, and form the area of concern that extends off-Station to the west. A third (minor) source area is Site 2 (Magazine Road Landfill).

PCE, TCE, 1,2-DCE and 1,1-DCE form a microbial degradation suite that is commonly exhibited when these VOCs are present in groundwater. These VOCs further degrade to vinyl chloride and chloromethane. Vinyl chloride is not detected in the site groundwater; therefore, either the degradation to vinyl chloride is not taking place, or the concentrations of PCE-TCE group compounds are not high enough to form vinyl chloride in sufficient amounts to be detected at 1 μg/L. The concentration of vinyl chloride is probably not detectable because of low concentrations of precursor VOCs and dilution along the groundwater flow path.

Benzene Group. The second group of contaminants, which includes only benzene and TFHs, is localized in two areas north of and separated from the PCE-TCE group areas. Benzene is a common component of TFH-gasoline. The TFHs include both gasoline and diesel fractions; both fractions may be present, or either fraction may dominate in groundwater at specific wells. Concentrations of benzene of up to 730 μg/L were detected in Well 13_UGMW32, which is directly adjacent to Tank Farm 2. No benzene has been detected in off-Station monitoring wells.

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A1.7 References

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Table A1-1
Results of Soil TOC and VOC Analyses in the Saturated Zone for All Sites (OUs 1,2 and 3)
MCAS El Toro Phase I RI Technical Memorandum

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Station Identification	Depth of Sample (feet bgs)	Sample Identification	Total Organic Carbon (TOC) (mg/kg)	Volatile Organic Compounds Detections	
				VOC	Value (µg/kg)
01_DGMW57	70	S1456000	104	2-Butanone	2.0 J
01-DBMW58	60	S1456001 S1457103	Less than 100 Less than 100	2-Butanone 2-Butanone	3.0 J 4.0 J
02_UGMW25	60	S1456013		Acetone	90
02_DGMW60	80	S1456011	103		
02_DGMW61	80	S1456026 S1457143	191 134		
03_UGMW26	255	S1456035			
03_DBMW39	235	S1456031	209	Acetone Methylene chloride	16 32 B
03_DBMW65	265	S1456034			
04_UGMW63	230	S1457145	103	Acetone	13.0
04_DGMW66	255	S1456064	169		
05_UGMW27	198	S1456078			
05_DBMW41	85	S1456065	100 J		
05_DGMW67	215	S1456069			
05_DGMW68	203	S1456070	127	Acetone	7.0
06_UGMW28	148	S1456089			
06_UGMW69	155	S1456093	104		
07_DBMW43	165	S145610601	212		
07_DBMW70	130	S1456106	164	Methylene chloride	4.0 J
07_DBMW100	128	S1457121			
08_UGMW29	118	S1456396	167 J		
08_DBMW73	110	S1456132	381	Acetone	17
08_DBMW74	100	S1456146 S1457068	233 Less than 100		
09_DBMW45	135	S1456149	177	Acetone	28
09_DGMW75	120	S1456153	Less than 100		
10_DGMW77	134	S1456179	Less than 100	Acetone	70
12_UGMW31	100 125	S1456196 S1456194	100 J 418 J	Acetone Acetone	69 30
12_DBMW48	100	S1456198	104	2-Butanone	4.0 J
13_UGMW32	30	S1456204	314 J	Benzene Acetone	6.0 J 48

Table A1-1
Results of Soil TOC and VOC Analyses in the Saturated Zone for All Sites (OUs 1,2 and 3)
MCAS El Toro Phase I RI Technical Memorandum

Station Identification	Depth of Sample (feet bgs)	Sample Identification	Total Organic Carbon (TOC) (mg/kg)	Volatile Organic Compounds Detections VOC	Value (µg/kg)
13-DBMW49	147	S1456203	183		
13_DGMW78	135	S1456676	Less than 100	Acetone	13
14_DBMW50	133	S1456218	Less than 100	Acetone	19
14_DGMW79	125	S1456414	Less than100	Acetone 2-Butanone Methylene chloride	10.0 JB 6.0 JB 5.0 JB
16_DBMW52	188	S1456248	106		
16_DGMW81	188	S1456260	106	2-Butanone	4.0 J
17_DGMW82	235 238	S1457171 S1457172	 107		
18_BGMW01B	400	S1456375	Less than 100		
18_BGMW01C	340	S1456386	118	Acetone Toluene	14 3 J
17_BGMW01E	210	S1456590	Less than 100		
18_BGMW02C	365	S1456350A	Less than 100		
18_BGMW02D	310	S145350	Less than 100	Acetone Toluene	28 3 J
18_BGMW02D		S1456356	420		
18_BGMW02D		S1456357	120		
18_BGMW03B	287	S1456378	158		
18_BGMW03C	225	S145639401	105		
18_BGMW03E	125	S1456412	133	Acetone Trichloroethylene	8 19
18_BGMW04B		S1456352	170		
18_BGMW05C	225	S1456388	Less than 100		
18_BGMW05D	89	S1457043	233		
18_BGMP06	380	S1456398	100		
18_BGMP08	60	S1456422	320		
	140	S1456423	209	Toluene	4 J
18_BGMW10	90	S1457076	106		
	443	S1456734	Less than 100		
	443	S1456735	130		
18_BGMW12	180	S1456761	Less than 100		
18_BGMW14	120	S1456359	Less than 100		

Table A1-1
Results of Soil TOC and VOC Analyses in the Saturated Zone for All Sites (OUs 1,2 and 3)
MCAS El Toro Phase I RI Technical Memorandum

Station Identification	Depth of Sample (feet bgs)	Sample Identification	Total Organic Carbon (TOC) (mg/kg)	Volatile Organic Compounds Detections	
				VOC	Value (µg/kg)
18_BGMW15	190	S1456364	130		
18_BGMW16	248	S145673	310		
18_BGMW17	244	S1456363	Less than 100		
18_BGMW18	185	S1456370	Less than 100		
18_BGMW19A	480	S1456391	Less than 100	Toluene	5 J
18_BGMW19B	380	S145639701	167	2-Butanone	5.0 J
18_BGMW19C	156	S1456424	Less than 117		
18_BGMW19E	122	S1456381	177	Acetone Methylene chloride	31 22
18_BGMW22	255	S1456301	118	Methylene chloride	12
18_BGMW23	90	S1456384	118	Acetone	27
18_BGMW24	60	S1457132	106		
19_UGMW35	148	S1457108 S1457110	208 210		
19_DBMW54	160	S1456304	212		
19_DGMW85	148	S1457089	104		
19_DGMW86	168	S1456300	103		
20_UGMW36	210	S1456331	122	Acetone Toluene	22 2.0 J
20_UGMW88	192	S145633201	Less than 100	Methylene chloride Toluene	9.0 JB 2.0 J
21_UGMW37	100	S1456394	100 J		
21_DBMW56	95	S1456573	Less than 100		
21_DBMW90	120	S1457091 S1457093	318 254		
22_DBMW47	135	S1456387	Less than 100	Methylene chloride Toluene Trichlorothylene	8.0 J 4.0 J 6.0 J

Note: Acetone, methylene chloride, and 2-butanone are demonstrated laboratory contaminants. The maximum detected concentrations in trip blanks are: acetone (37 µg/L); methylene chloride (42 µg/L); and 2-butanone (33 µg/L).

[a]J indicates an estimated value.
[b]B indicates that this compound was also detected in the laboratory blank.

Table A1-2
OU-1 (Site 18) - Regional Groundwater
Sample Locations and Analytes
MCAS El Toro Phase I RI Technical Memorandum

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Station Identification	Sample Identification	Sample Depth (ft)	Groups of Analytes Requested[a]											
			VOCs	Semi-VOCs	Pesticides/ PCBs	Herbicides	TPH	TFH	Metals	TCN	General Chemistry	TOC	Dioxins/ Furans	Gross Alpha/ Beta
Groundwater Samples from Newly Constructed Wells														
18_BGMW01A	S14522139	466-486	X	X	X	X	X	X	X	X	X			
18_BGMW01B	S1452236	396-416	X	X	X	X	X	X	X	X	X			
18_BGMW01C	S1452238 S1452156[c]	330-350	X X	X	X	X	X	X	X	X	X			
18_BGMW01D	S1452249 S1452179[c]	242-262	X X	X	X	X	X	X	X	X	X			
18_BGMW01E	S1452242 S1452382 S1452240[c]	205-225	X X	X	X	X	X	X	X	X	X			
18_BGMW02A	S1452244 S1452106[b] S1452136[b]	462-482	X X X	X	X	X	X	X	X	X	X			
18_BGMW02C	S1452246 S1452143[c]	358-378	X X	X	X	X	X	X	X	X	X			
18_BGMW02D	S1452248 S1452143[b] S1452144[b]	294-314	X X X	X	X	X	X	X	X	X	X			
18_BGMW02E	S1452225 S1452138	198-233	X X	X	X	X	X	X	X	X	X			
18_BGMW03A	S1452251 S1452149[c] S1452148[c]	370-390	X X X	X	X	X	X	X	X	X	X			
18_BGMW03B	S1452253 S1452384[b]	280-300	X X	X X	X X	X X	X X	X X	X X	X X	X X			
18_BGMW03C	S1452255	222-242	X	X	X	X	X	X	X	X	X			
18_BGMW03E	S1452257	124-164	X	X	X	X	X	X	X	X	X			
18_BGMW04A	S1452231 S1452140[c]	286-306	X X	X	X	X	X	X	X	X	X			
18_BGMW04B	S1452235 S1452109[c]	190-210	X X	X	X	X	X	X	X	X	X			
18_BGMW05A	S1452259 S1452155[c]	462-482	X X	X	X	X	X	X	X	X	X			
18_BGMW05B	S1452261	321-341	X	X	X	X	X	X	X	X	X			
18_BGMW05C	S1452263 S1452465[b] S1452158[c]	225-245	X X X	X X	X X	X X	X X	X X	X X	X X	X X			
18_BGMW05D	S1452265	83-133	X	X	X	X	X	X	X	X	X			
18_BGMW05E	Two-inch diameter piezometric well - no groundwater sample collected													

Table A1-2
OU-1 (Site 18) - Regional Groundwater
Sample Locations and Analytes
MCAS El Toro Phase I RI Technical Memorandum

Station Identification	Sample Identification	Sample Depth (ft)	Groups of Analytes Requested[a]											
			VOCs	Semi-VOCs	Pesticides/PCBs	Herbicides	TPH	TFH	Metals	TCN	General Chemistry	TOC	Dioxins/Furans	Gross Alpha/Beta
18_BGMP06	S1452182[b] S1452183[b] S1452184[b] S1452185[b] S1452192[b] S1452193[b] S1452197[b]	Develop-ment: open to all screens	X X X X X X X											
18_BGMP06	S1452267 S1452465[b]	445-455	X X	X X	X X		X X	X X	X X	X X	X X			
	S1452269	380-390	X	X	X		X	X	X	X	X			
	S1452271	295-305	X	X	X		X	X	X	X	X			
	S1452273	168-178	X	X	X		X	X	X	X	X			
	S1452275	105-115	X	X	X		X	X	X	X	X			
18_BGMW07	S1452277 S1452166[b]	25-65	X X	X X	X X		X X	X X	X X	X X	X X			
18_BGMP08	S1452279	439-449	X	X	X	X	X	X	X	X	X			
	S1452281	297-307	X	X	X	X	X	X	X	X	X			
	S1452285	61-67	X	X	X	X	X	X	X	X	X			
	S1452283 S1452333[b]	126-136	X X	X X	X X	X X	X X	X X	X X	X X	X X			
18-BGMP09	S1452164[b] S1452178[b] S1452170[b] S1452173[b]	Develop-ment: open to all screens	X X X X											
18_BGMP09	S1452287	543-463	X	X	X	X	X	X	X	X	X			
	S1452289	374-384	X	X	X	X	X	X	X	X	X			
	S1452291	268-278	X	X	X	X	X	X	X	X	X			
	S1452293	222-232	X	X	X	X	X	X	X	X	X			
	S1452295 S1452361	133-143	X	X	X	X	X	X	X	X	X			
	S1452297	59-69	X	X	X	X	X	X	X	X	X			
18_BGMP10	S1452299	1001-1011	X	X	X		X	X	X	X	X			
	S1452488 s1452498[b]	887-897	X X	X X	X X		X X	X X	X X	X X	X X			
	S1452490	752-762	X	X	X		X	X	X	X	X			
	S1452492	563-573	X	X	X		X	X	X	X	X			

Table A1-2
OU-1 (Site 18) - Regional Groundwater
Sample Locations and Analytes
MCAS El Toro Phase I RI Technical Memorandum

Station Identi-fication	Sample Identi-cation	Sample Depth (ft)	Groups of Analytes Requested[a]											
			VOCs	Semi-VOCs	Pesti-cides/ PCBs	Herbi-cides	TPH	TFH	Metals	TCN	General Chemistry	TOC	Dioxins/ Furans	Gross Alpha/ Beta
	S1452494	429-439	X	X	X		X	X	X	X	X			
	S1452496	218-228	X	X	X		X	X	X	X	X			
18_BGMW12	S1452301	165-205	X	X	X	X	X	X	X	X	X			
18_BGMW14	S1452303 S1452147[c] S1452145[c]	75-115	X X X	X	X	X	X	X	X	X	X			
18_BGMW15	S1452305	175-215	X	X	X	X	X	X	X	X	X			
18_BGMW16	S1452307 S1452378[b]	223-263	X x	X x	X x	X X	X	X	X	X	X			
18_BGMW17	S1452309	215-255	X	X	X	X	X	X	X	X	X			
18_BGMW18	S1452311	140-180	X	X	X	X	X	X	X	X	X			
18_BGMW19A	S1452313 S1452160[c] S1452177[c]	448-468	X X X	X	X	X	X	X	X	X	X			
18_BGMW19B	S1452315 S1452181[c]	400-420	X	X	X	X	X	X	X	X	X			
18_BGMW19C	S1452226 S1452227[b]	257-277	X X	X X	X X	X X	X X	X X	X X	X X	X X			
18_BGMW19D	S1452229	150-170	X	X	X	X	X	X	X	X	X			
18_BGMW19E	S1452317	98-138	X	X	X	X	X	X	X	X	X			
18_BGMW22	S1452319 S1452186[c] S1452187[c]	247-287	X X X	X	X	X	X	X	X	X	X			
18_BGMW23	S1452321 S1452195	64-104	X X	X	X	X	X	X	X	X	X			
18_BGMW24	S1452323	51-71	X	X	X	X	X	X	X	X	X			
18_BGMW101	S1452330	90-130	X	X	X	X	X	X	X	X	X			
18_BGMW103	Six-inch diameter piezometric well - no groundwater sample collected													
Groundwater from Previously Constructed On-Station Wells														
18_DW135	S1452477 S1452478[b]	115-135	X X	X X	X X	X X	X X	X X	X X	X X	X X			
18_DW250	S1452479	214-250	X	X	X	X	X	X	X	X	X			
18_DW350	S1452480	310-350	X	X	X	X	X	X	X	X	X			
18_DW450	S1452481	420-450	X	X	X	X	X	X	X	X	X			
18_DW540	S1452482	490-540	X	X	X	X	X	X	X	X	X			
18_PS2	S1452337	103-	X	X	X	X	X	X	X	X	X			

Table A1-2
OU-1 (Site 18) - Regional Groundwater
Sample Locations and Analytes
MCAS El Toro Phase I RI Technical Memorandum

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Station Identification	Sample Identification	Sample Depth (ft)	Groups of Analytes Requested[a]											
			VOCs	Semi-VOCs	Pesticides/PCBs	Herbicides	TPH	TFH	Metals	TCN	General Chemistry	TOC	Dioxins/Furans	Gross Alpha/Beta
18_PS3	S1452339	102-	X	X	X	X	X	X	X	X	X			
18_PS4	S1452341	98-	X	X	X	X	X	X	X	X	X			
18_PS5	S1452343	106-	X	X	X	X	X	X	X	X	X			
18_PS6	S1452345 S1452390[b]	130-	X X	X X	X X	X X	X X	X X	X X	X X	X X			
18_PS7	S1452347	106-	X	X	X	X	X	X	X	X	X			
18_PS8	S1452349	125-	X	X	X	X	X	X	X	X	X			
18_RW1	S1452351 S1452353[b]	430-	X X	X X	X X	X X	X X	X X	X X	X X	X X			
18_RW2	S1452353	270-	X	X	X	X	X	X	X	X	X			

[a]VOCs = Volatile organic chemicals, Semi-VOCs=semivolatile organic chemicals, Pest/PCBs = Pesticides and polychlorinated biphynols, Herb = Herbicides, TPH = Total recoverable petroleum hydrocarbons (EPA Method 418.1), TFH = Total fuel hydrocarbons (EPA Method 8015 modified), TCN = Total cyanide, TOC = Total organic carbon.
[b]Duplicate of previous sample.
[c]Sample collected during development for 48-hour turnaround analysis of VOCs only.

Table A1-3
OU-1 (Site 18): Well Construction Details
MCAS El Toro Phase I RI Technical Memorandum

Item	Station Identification Well Cluster 18_BGMW01A	18_BGMW01B	18_BGMW01C	18_BGMW01D	18_BGMW01E
Survey Location--Northing Survey Location--Easting	551991.14 1553363.32	552010.90 1553360.94	551989.03 1553383.08	551997.41 1553342.28	551972.33 1553350.10
Ground Surface Elev. (ft above MSL[a]) Measuring Point Elev. (ft above MSL[a])	392.79 393.41	393.19 393.83	392.62 393.25	392.53 393.15	391.48 392.09
Measuring Point Location	Top of sounding tube	Top of sounding tube	Top of sounding tube	Top of sounding tube	Top of sounding tube
Type of Surface Completion	Above ground	Above ground	Above ground	Above ground	Above ground
Casing Diameter and Material	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC	4-inch dia. Sch. 40 PVC
Screen Diameter and Material	5-inch dia. 20-slot SS	5-inch dia. 20-slot SS	5-inch dia. 20-slot SS	5-inch dia. 20-slot SS	4-inch dia. 20-slot SS
Screen Interval (ft bgs[b])	466-486	396-416	330-350	242-262	205-225
Length of Drop Pipe (ft bgs[b])	465	395	329	231	224
Make and Model of Installed Pump	Grundfos 5S07-18 High Head	Grundfos 5S07-18 High Head	Grundfos 5S07-18 High Head	Grundfos 10E-11	Grundfos Rediflow 2
Date of Pumping Test	14 Oct 92	16 Oct 92	Not tested	Not tested	14 Oct 92
Date of Water Quality Sampling	11 Dec 92	14 Dec 92	16 Dec 92	09 Dec 92	28 Oct 92

Table A1-3
OU-1 (Site 18): Well Construction Details
MCAS El Toro Phase I RI Technical Memorandum

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Item	Station Identification			
	Well Cluster			
	18_BGMW02A	18_BGMW02C	18_BGMW02D	18_BGMW02E
Survey Location--Northing Survey Location--Easting	584256.43 1554588.78	584252.95 1554596.65	548259.34 1554576.32	548246.82 1554584.61
Ground Surface Elev. (ft above MSL[a]) Measuring Point Elev. (ft above MSL[a])	391.12 391.81	391.12 391.75	390.77 391.45	390.97 391.72
Measuring Point Location	Top of sounding tube	Top of sounding tube	Top of sounding tube	Top of sounding tube
Type of Surface Completion	Above ground	Above ground	Above ground	Above ground
Casing Diameter and Material	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC
Screen Diameter and Material	5-inch dia. 20-slot SS	5-inch dia. 20-slot SS	5-inch dia. 20-slot SS	5-inch dia. 20-slot SS
Screen Interval (ft bgs[b])	462-482	358-378	294-314	198-233
Length of Drop Pipe (ft bgs[b])	461	357	293	200
Make and Model of Installed Pump	Grundfos 5S07-18 High Head	Grundfos 5S07-18 High Head	Grundfos 5S07-18 High Head	Grundfos Rediflow 2
Date of Pumping Test	19 Oct 92	19 Oct 92	19 Oct 92	21 Sep 92
Date of Water Quality Sampling	21 Dec 92	21 Dec 92	22 Dec 92	21 Oct 92

Table A1-3
OU-1 (Site 18): Well Construction Details
MCAS El Toro Phase I RI Technical Memorandum

Item	Station Identification			
	Well Cluster			
	18_BGMW03A	18_BGMW03B	18_BGMW03C	18_BGMW03E
Survey Location--Northing Survey Location--Easting	548416.31 1548069.54	548425.16 1548072.70	548419.01 1548076.01	548422.71 1548066.47
Ground Surface Elev. (ft above MSL[a]) Measuring Point Elev. (ft above MSL[a])	279.60 279.25	279.58 279.28	279.72 279.41	279.45 279.16
Measuring Point Location	Top of sounding tube	Top of sounding tube	Top of sounding tube	Top of sounding tube
Type of Surface Completion	Below ground	Below ground	Below ground	Below ground
Casing Diameter and Material	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC	4-inch dia. Sch. 40 PVC
Screen Diameter and Material	5-inch dia. 20-slot SS	5-inch. dia. 20-slot SS	5-inch dia. 20-slot SS	4-inch dia. 20-slot SS
Screen Interval (ft bgs[b])	370-390	280-300	222-242	124-164
Length of Drop Pipe (ft bgs[b])	369	279	221	160
Make and Model of Installed Pump	Grundfos 10E-11	Grundfos 10E-11	Grundfos 10E-11	Grundfos Rediflow 2
Date of Pumping Test	28 Oct 92	Not tested	15 Oct 92	15 Oct 92
Date of Water Quality Sampling	28 Oct 92	17 Dec 92	17 Dec 92	17 Dec 92

Table A1-3
OU-1 (Site 18): Well Construction Details
MCAS El Toro Phase I RI Technical Memorandum
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Item	Station Identification	
	Well Cluster	
	18_BGMW04A	18_BGMW04B
Survey Location--Northing Survey Location--Easting	549006.38 1545170.06	549001.27 1545178.44
Ground Surface Elev. (ft above MSL[a]) Measuring Point Elev. (ft above MSL[a])	242.65 243.36	242.88 243.58
Measuring Point Location	Top of sounding tube	Top of sounding tube
Type of Surface Completion	Above ground	Above ground
Casing Diameter and Material	5-inch dia. Sch. 80 PVC	4-inch dia. Sch. 40 PVC
Screen Diameter and Material	5-inch dia. 20-slot SS	4-inch dia. 20-slot SS
Screen Interval (ft bgs[b])	286-306	190-210
Length of Drop Pipe (ft bgs[b])	285	189
Make and Model of Installed Pump	Grundfos 10E-11	Grundfos 10E-11
Date of Pumping Test	28 Sep 92	29 Sep 92
Date of Water Quality Sampling	30 Sep 92	29 Sep 92

Table A1-3
OU-1 (Site 18): Well Construction Details
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Item	Station Identification				
	Well Cluster				
	18_BGMW05A	18_BGMW05B	18_BGMW05C	18_BGMW05D	18_BGMW05E
Survey Location--Northing Survey Location--Easting	546206.29 1548486.53	546214.40 1548494.37	546213.50 1548489.90	546016.69 1548633.56	545959.08 1548716.25
Ground Surface Elev. (ft above MSL[a]) Measuring Point Elev. (ft above MSL[a])	270.23 269.45	269.95 270.41	270.11 269.39	270.90 270.42	270.02 269.41
Measuring Point Location	Top of sounding tube	Top of sounding tube	Top of sounding tube	Top of sounding tube	Top of sounding tube
Type of Surface Completion	Below ground	Below ground	Below ground	Below ground	Below ground
Casing Diameter and Material	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC	5-inch dia. Sch. 80 PVC	6-inch dia. Sch. 80 PVC	2-inch dia. Sch. 40 PVC
Screen Diameter and Material	5-inch dia. 20-slot SS	5-inch dia. 20-slot SS	5-inch dia. 20-slot SS	6-inch dia. 20-slot SS	2-inch dia. 20-slot SS
Screen Interval (ft bgs[b])	462-482	321-341	225-245	83-133	80-130
Length of Drop Pipe (ft bgs[b])	261	320	223	126	None
Make and Model of Installed Pump	Grundfos 5S07-18 High Head	Grundfos 10E-11	Grundfos 10E-11	Grundfos 10E-11	None
Date of Pumping Test	21 Oct 92	11 Nov 92	10 Nov 92	03 Nov 92	None
Date of Water Quality Sampling	15 Dec 92	11 Nov 92	10 Nov 92	04 Nov 92	None

Table A1-3
OU-1 (Site 18): Well Construction Details
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Item	Station Identification				
	Multiple-Port 18_BGMW06	Multiple-Port 18_BGMW07	Multiple-Port 18_BGMP08	Multiple-Port 18_BGMP09	Multiple-Port 18_BGMP10
Survey Location--Northing Survey Location--Easting	553966.34 1539289.08	544789.06 1541175.14	547715.55 1542151.23	544903.93 1546380.38	560554.23 1528333.37
Ground Surface Elev. (ft above MSL[a]) Measuring Point Elev. (ft above MSL[a])	176.49 175.41	179.46 180.11	194.19 NA	234.70 235.A3	57.71 58.24
Measuring Point Location	Top of sounding tube	Top of sounding tube	NA	NA	PVC North Side
Type of Surface Completion	Above ground	Above ground	Above ground	Below ground	Below ground
Casing Diameter and Material	4-inch dia. Sch. 40 Carbon/SS	4-inch dia. Sch. 40 PVC	4-inch dia. Sch. 40 Carbon/SS	4-inch dia. Sch. 40 Carbon/SS	4-inch dia. Sch. 40 Carbon/SS
Screen Diameter and Material	4-inch dia. Sch. 40 20-slot SS	4-inch dia. 20-slot SS	4-inch dia. Sch. 40 20-slot SS	4-inch dia. Sch. 40 20-slot SS	4-inch dia. Sch. 40 20-slot SS
Screen Interval (ft bgs[b])	445-455 (A) 380-390 (B) 295-305 (C) 168-178 (D) 105-115 (E)	25-65	439-449 (A) 297-307 (C) 126-136 (D) 61-71 (E)	453-463 (A) 374-384 (B) 268-278 (C) 222-232 (D) 133-143 (E) 59-69 (F)	1001-1011 (A) 887-897 (B) 752-762 (C) 563-573 (D) 429-439 (E) 218-299 (F)
Length of Drop Pipe (ft bgs[b])	NA	60	NA	NA	NA
Make and Model of Installed Pump	NA (Westbay)	Grundfos Rediflow 2	NA	NA	NA
Date of Pumping Test	NA	Not tested	NA	NA	--
Date of Water Quality Sampling	08 Oct 92 (A) 07 Oct 92 (B) 07 Oct 92 (C) 06 Oct 92 (D) 01 Oct 92 (E)	09 Dec 92	17 Oct 92 (A) 15 Oct 92 (C) 13 Oct 92 (D) 12 Oct 92 (E)	23 Oct 92 (A) 23 Oct 92 (B) 22 Oct 92 (C) 21 Oct 92 (D) 20 Oct 92 (E) 19 Oct 92 (F)	20 Jan 93 (A) 25 Jan 93 (B) 23 Jan 93 (C) 22 Jan 93 (D) 21 Jan 93 (E) 20 Jan 93 (F)

Continue

Table A1-3
OU-1 (Site 18): Well Construction Details
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Item	Station Identification					
	18_BGMW12	18_BGMW14	18_BGMW15	18_BGMW16	18_BGMW17	18_BGMW18
Survey Location--Northing Survey Location--Easting	554228.11 1547466.07	544818.63 1549691.41	559058.51 15484443.79	557141.18 1551376.89	546491.03 1554512.70	555623.69 1545497.92
Ground Surface Elev. (ft above MSL[a]) Measuring Point Elev. (ft above MSL[a])	304.68 304.44	268.17 268.67	319.93 319.59	375.91 376.67	376.07 375.68	275.91 276.49
Measuring Point Location	Top of sounding tube	Top of sounding tube	Top of sounding tube	Top of sounding tube	Top of sounding tube	Top of sounding tube
Type of Surface Completion	Below ground	Above ground	Below ground	Above ground	Below ground	Above ground
Casing Diameter and Material	4-inch dia. Sch. 40 PVC	4-inch dia. Sch. 40 PVC	4-inch dia. Sch. 40 PVC	5-inch dia. Sch. 40 PVC	5-inch dia. Sch. 40 PVC	4-inch dia. Sch. 40 PVC
Screen Diameter and Material	4-inch dia. 20-slot SS	4-inch dia. 20-slot SS	4-inch dia. 20-slot SS	5-inch dia. 20-slot SS	5-inch dia. 20-slot SS	4-inch dia. 20-slot SS
Screen Interval (ft bgs[b])	165-205	75-115	175-215	223-263	215-255	140-180
Length of Drop Pipe (ft bgs[b])	200	113	214	252	231	175
Make and Model of Installed Pump	Grundfos Rediflow 2	Grundfos Rediflow 2	Grundfos Rediflow 2	Grundfos 5S07-18 High Head	Grundfos 10E-11	Grundfos Rediflow 2
Date of Pumping Test	06 Nov 92	20 Oct 92	29 Oct 92	23 Oct 92	22 Oct 92	10 Nov 92
Date of Water Quality Sampling	09 Nov 92	20 Oct 92	30 Oct 92	23 Oct 92	22 Oct 92	10 Nov 92